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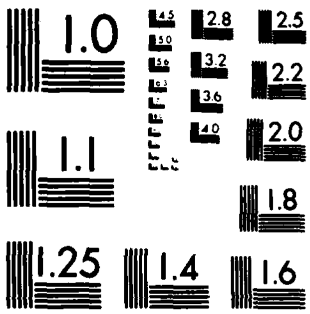

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Buffalo Harbor Study

Preliminary Feasibility Report
Volume II
Appendices

Revised April 1983

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Buffalo Harbor
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The Buffalo Harbor Study, which began in December 1979, is a six-year planning effort that is being conducted by the Buffalo District Corps of Engineers.The purpose of the styudy is to determine the feasibility of making commercial navigation improvements to the harbor so that industries which depend on water transportation in Buffalo can operate more efficiently in the future. Thus far, in the study, four categiries of improvements have been considered: (1) Realizing the Buffalo River; (2) deepening the Buffalo River

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for 700-foot vessels; (3) transhipment of raw materials upriver and (4) improvements to the South Entrance Channel. The Reconnaissance Report, which is the predecessor of the Preliminary Feasibilty Report (PFR),concluded that realizing the Buffalo River was not ecenomically feasible. The conclusion of the PFR is that deepening of the Buffalo River for 700-foot vessels is also commercial navigation and a couple of other supplementary investigations will appear in the Final fEasibility Reports scheduled for completio-n in September 1986.

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COASTAL ENGINEERING DESIGN

BUFFALO HARBOR, NY

STAGE II
PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

BUFFALO HARBOR, NEW YORK
PRELIMINARY FEASIBILITY REPORT

APPENDIX A
COASTAL ENGINEERING DESIGN

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APPENDIX A
COASTAL ENGINEERING DESIGN

A1. INTRODUCTION

The fundamental commercial navigation issue in the Buffalo Harbor study is the evaluation of modifications to existing harbor features in order to provide more efficient and safer movement of waterborne commerce through the Port of Buffalo. This appendix presents the design criteria, assumptions, and detailed design of the harbor modifications required to permit operation of Great Lakes bulk cargo vessels, up to 1,000 feet in length with a draft of 25.5 feet, in the Outer Harbor of the Port of Buffalo. Also included in this appendix is a discussion of improvements required in the Buffalo River to permit vessels in the present fleet (up to 630-foot long X 68 feet wide vessels) destined for upriver docks to navigate the river at fully loaded drafts of 25.5 feet. A secondary issue of the Buffalo Harbor study is the design associated with recreational opportunities that can be provided by upgrading the existing Niagara Frontier Transportation Authority (NFTA) small-boat harbor facilities, and construction of offshore islands.

1,000-foot long vessels presently service only the south end of the Outer Harbor of the Port of Buffalo and utilize only the south entrance channel from Lake Erie (see existing Buffalo Harbor area shown on Plate A1). The south entrance channel is also used by smaller size vessels which service the south end of the Outer Harbor, smaller vessels (less than 1,000 feet) which service the Niagara Frontier Transportation Authority (NFTA) docks located in the center of the Outer Harbor area, and occassionally by smaller vessels (630 feet and less) which navigate the Buffalo River if entrance conditions are too severe to use the north entrance channel. The south entrance consists of a dredged channel between the southern end of the South Breakwater and the south entrance arm and Stony Point breakwater. The south entrance channel consists of: an outer area 30 feet deep and 1,000 feet wide from deep water in the lake to a point just lakeward of the South Pierhead Light; an inner area 29 feet deep beginning at the landward end of the outer area limit, tapering to 400 feet wide between the 500-foot wide opening at the end of the South Breakwater and the angle junction point of the South Entrance Arm and Stony Point breakwater and; a 28-foot deep inner channel in the southern Outer Harbor channel. The dimensions of the entrance features at the south entrance are depicted on Plate A2.

Nearly all vessels destined for docks located along the Buffalo River presently use the north entrance channel (occassionally, they use the south entrance when entrance conditions are too severe in the north channel) from Lake Erie into the Outer Harbor (see existing Buffalo Harbor area shown on Plate A1). The north entrance consists of a dredged channel 800 feet wide from deep water in the lake to the northern Outer Harbor channel with a depth of 25 feet in soft material and 26 feet in hard material. The dimensions of the entrance features at the north entrance are depicted on Plate A3.

The many obstacles at the north and south entrances (i.e., pierhead lights, breakwater ends, etc.) represent hazards to vessels, particularly during storm

conditions. The channel depths are also inadequate for vessel clearance under pitching and rolling conditions. Therefore, alternative entrance plans for operation of vessels in the Outer Harbor of the Port of Buffalo were developed at the north and south entrances. Structural improvements consisting of construction of new breakwaters and modifications to existing breakwaters, in addition to deepening and enlargement of existing channels, are required at the south entrance location whereas only deepening of existing channels is required at the north entrance.

In addition to the plans at the existing north and south entrances, a plan of improvement was developed to facilitate maneuvering of vessels through the Outer Harbor channels. The Outer Harbor, as shown on Plate A1, consists of: a 4,000-foot long, 1,400-foot wide and 28 feet deep southern Outer Harbor channel; an 11,000-foot long, 1,400-foot wide and 23 and 27 feet deep middle Outer Harbor channel; and a 4,800-foot long, 1,400-foot wide, and 23 feet deep northern Outer Harbor channel. The plans of improvement for the Outer Harbor would not require structural improvements but would entail channel deepening through nearly the entire 4.0-mile long Outer Harbor area.

NATURAL FACTORS AFFECTING DESIGN AND NAVIGATION CONDITIONS

A2. EXPOSURE TO AND EFFECTS OF STORMS

Buffalo Harbor is exposed to storm waves generated by winds from the south (180 degrees) through west to north-northwest (340 degrees) directions. Storm waves from the southwesterly directions have the greatest fetch and cause the most severe wave action at Buffalo Harbor. A wind diagram showing the relative directional frequency and intensity of winds at Buffalo, NY, based on United States Coast Guard recorded observations, is shown on Figure A1. The wind diagram is considered to reflect, reasonably well, the conditions that prevail at Buffalo Harbor.

A3. WATER LEVELS AND FLUCTUATIONS

Water levels on the Great Lakes vary from year to year and from month to month. Locally, water levels vary from day to day and from hour to hour. The lake level is subject to a seasonal rise and fall usually consisting of high levels in May and June and low levels in January and February. Yearly and seasonal fluctuations are caused by variations in precipitation rates within the Great Lakes Basin. Short-term fluctuations lasting from a few hours to several days are caused by meteorological disturbances. Differences in barometric pressure and winds blowing over the surface of the lake create temporary water level fluctuations which vary locally. Astronomical tides are assumed to have a negligible influence on water levels at the project site.

Continous records of water levels in Lake Erie have been monitored at Cleveland, OH, by the Lake Survey Center and National Oceanic and Atmospheric Administration (NOAA) since 1860. The gage at Cleveland serves as the master gage for Lake Erie. Table A1 summarizes the average and extreme water levels recorded by the Cleveland water level gage. In the 122 years of record at the Cleveland gage, from 1860 to 1981 inclusive, the level

of Lake Erie has fluctuated from a high monthly mean of 573.5 feet in June 1973 to a low monthly mean of 567.5 feet in December 1934 and again in February 1936. The greatest annual fluctuation, as shown by the highest and lowest monthly mean of the year, was 2.75 feet in 1947, and the least annual fluctuation was 0.87 foot in 1895. In the last 5 years of record (1977 to 1981), the maximum monthly mean stages have ranged from +3.96 feet in June 1980 to +3.34 feet above low water datum in May 1977. The minimum monthly mean stages have ranged from +2.55 feet in December 1980 to +1.62 feet above low water datum in February 1977. Similar fluctuations are assumed to occur during the life of the project.

A4. DEEP WATER WAVE CHARACTERISTICS

a. General.

Buffalo Harbor, NY, can be subjected to waves spanning approximately 160 degrees of Lake Erie from the south through west to north-northwest directions. This range extends from approximately 180 degrees (south) to 340 degrees (north-northwest). Three angle classes can be defined as viewed by an observer standing on shore and are depicted on Figure A2 and distinguished below:

(1) Angle Class 1 - Mean wave approach angle greater than 30 degrees to the right of a normal to shore (270 degrees through 340 degrees);

(2) Angle Class 2 - Mean wave approach angle within 30 degrees to either side of a normal to shore (210 degrees through 270 degrees);

(3) Angle Class 3 - Mean wave approach angle greater than 30 degrees to the left of a normal to shore (180 degrees through 210 degrees).

b. Significant Deep Water Wave Heights (H_o).

The significant deep water wave heights which can be expected at Buffalo, NY, were determined by Waterways Experiment Station and published in Technical Report H-76-1, entitled "Design Wave Information for the Great Lakes - Report 1," dated January 1976. Table A2 presents the significant deep water wave heights at Buffalo, NY, for three angle classes as distinguished above, for each season of the year, and for various recurrence intervals.

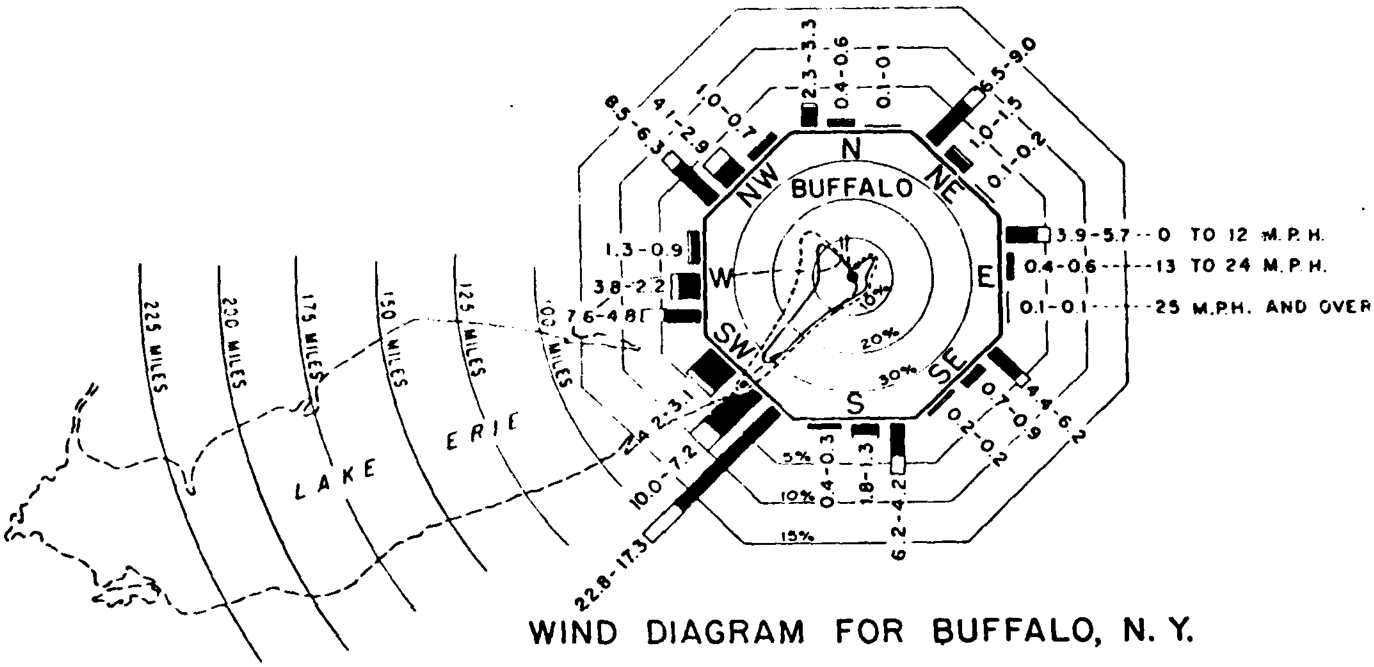
c. Wave Period (T_o).

Table A3 presents the wave periods associated with each significant deep water wave height at Buffalo, NY, as a function of angle class and wave height as presented in Technical Report H-76-1.

DETAILED STRUCTURAL DESIGN

A5. DESIGN CRITERIA AND ASSUMPTIONS

This section will address the criteria and assumptions for the detailed design of the channels and structural features for modification of the south



WIND DIAGRAM FOR BUFFALO, N. Y.

NOTES

INDICATES DURATION FOR ICE-FREE PERIOD (MAR. TO DEC. INCL.) IN PERCENT OF TOTAL DURATION.

INDICATES DURATION FOR ICE PERIOD (JAN. TO FEB. INCL.) IN PERCENT OF TOTAL DURATION.

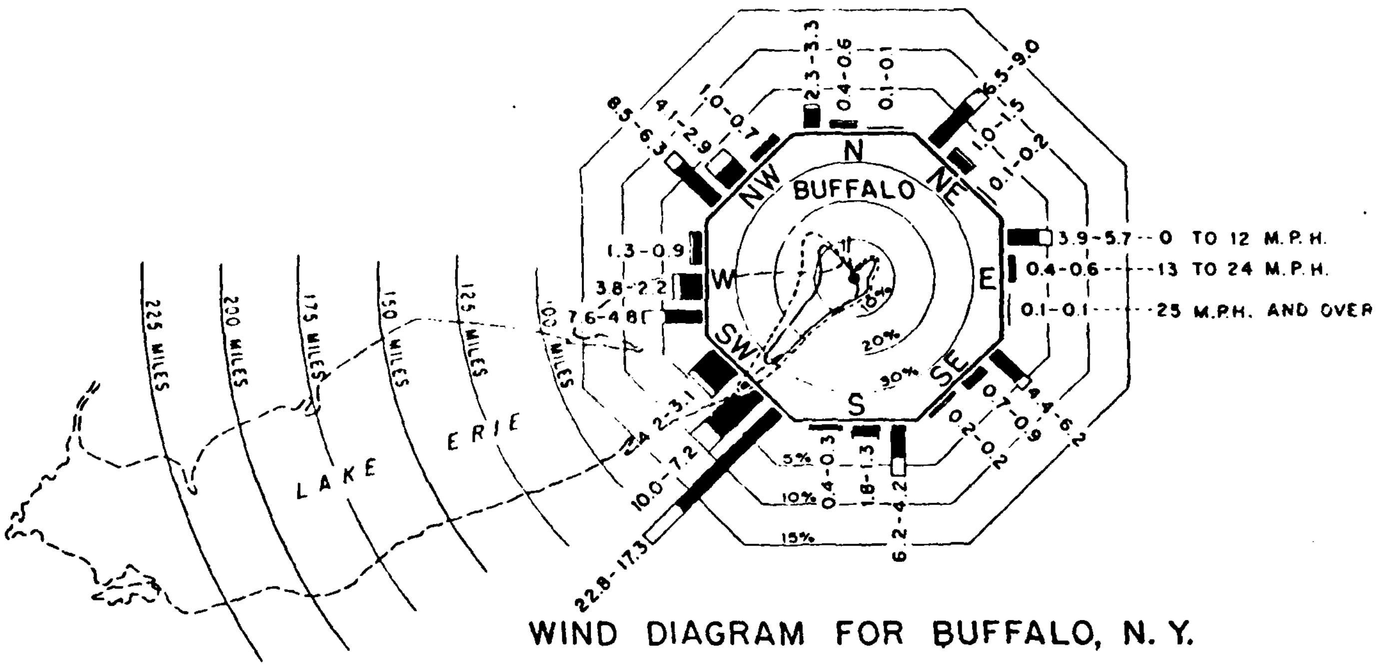
INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING ICE-FREE PERIOD.

INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE-FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U. S. COAST GUARD AT BUFFALO, N. Y. FOR PERIOD 1 JAN. 1936 TO 31 DEC. 1943 AND 1 JAN. 1947 TO 31 DEC. 1971

Figure A1



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INDICATES PERCENT OF TOTAL WIND MOVEMENT OCCURRING DURING COMBINED ICE AND ICE-FREE PERIODS.

FIGURES AT ENDS OF BARS INDICATE PERCENT OF TOTAL WIND DURATION FOR ICE-FREE PERIOD AND COMBINED ICE-FREE AND ICE PERIODS, RESPECTIVELY.

WIND DATA BASED ON RECORDS OF THE U. S. COAST GUARD AT BUFFALO, N. Y. FOR PERIOD 1 JAN. 1936 TO 31 DEC. 1943 AND 1 JAN. 1947 TO 31 DEC. 1971

Figure A1

Table A1 - Average and Extreme Water Levels

LAKE ERIE WATER LEVEL DATA
AT
CLEVELAND, OH
PERIOD 1860-1981

STAGE	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
	1973	1973	1973	1973	1973	1973	1973	1973	1973	1973	1972	1972
HIGH	572.39	572.53	572.88	573.30	573.25	573.51	573.34	573.03	572.51	572.14	572.17	572.35
MEAN	569.98	569.94	570.18	570.71	571.04	571.18	571.14	570.95	570.67	570.34	570.08	570.01
	1935	1936	1934	1934	1934	1934	1934	1934	1934	1934	1934	1934
LOW	567.62	567.49	567.65	568.20	568.46	568.46	568.46	568.36	568.23	567.95	567.60	567.53

						CHANGES						
	Jan-Feb	Feb-Mar	Mar-Apr	Apr-May	May-Jun	Jun-Jul	Jul-Aug	Aug-Sep	Sep-Oct	Oct-Nov	Nov-Dec	Dec-Jan
	1952	1976	1913	1947	1892	1902	1915	1926	1926	1917	1927	1949-50
MAXIMUM RISE	+0.67	+1.12	+1.57	+0.95	+0.76	+0.63	+0.26	+0.13	+0.28	+0.14	+0.52	+0.78
AVERAGE	-0.04	+0.24	+0.53	+0.32	+0.15	-0.04	-0.19	-0.28	-0.33	-0.27	-0.06	-0.03
	1886	1931	1891	1891	1977	1890	1868	1937	1871	1924	1882	1917-18
MAXIMUM FALL	-0.73	-0.31	-0.13	-0.18	-0.24	-0.38	-0.52	-0.57	-0.67	-0.64	-0.51	-0.67

Ave. 1860-1981 570.52
Ave. 1900-1981 570.38

LWD 568.6

July 1982

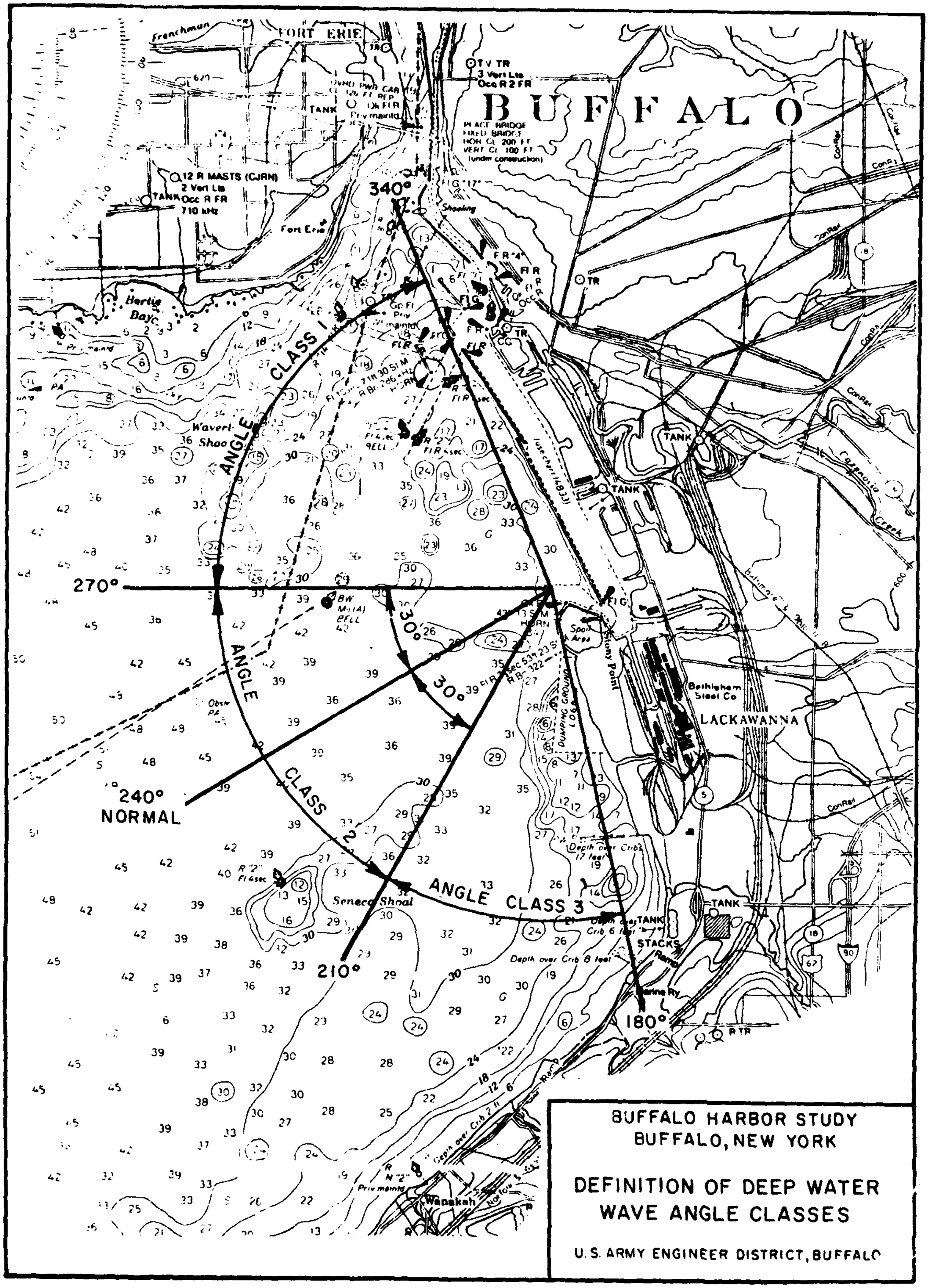

BUFFALO
FORT ERIE
LACKAWANNA
Bethlehem Steel Co
Stony Point
Seneca Shoal
Hertle Bay
Wanakah
340°
270°
240° NORMAL
210°
180°
30°
30°
ANGLE CLASS 1
ANGLE CLASS 2
ANGLE CLASS 3
TANK
TV TR
12 R MASTS (CJRN)
Cazenovia Creek
Smokes Creek
Depth over Crib 8 feet
Depth over Crib 17 feet
DUMPING GROUND
STACKS
Marine Ry
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
DEFINITION OF DEEP WATER
WAVE ANGLE CLASSES
U.S. ARMY ENGINEER DISTRICT, BUFFALO

FIGURE A2

Table A2 - Significant Deep Water Wave Heights at Buffalo, NY

Recurrence Interval (Years)	Angle Class 1 Wave Height (Feet)	Angle Class 2 Wave Height (Feet)	Angle Class 3 Wave Height (Feet)
		Winter	
5	4.3	14.4	2.0
10	4.9	16.1	3.3
20	5.6	17.7	4.6
50	6.6	20.0	6.9
100	7.2	21.6	8.2
		Spring	
5	2.3	9.5	1.6
10	3.3	10.8	2.0
20	4.3	12.1	2.6
50	5.6	14.1	3.0
100	6.6	15.4	3.6
		Summer	
5	2.0	9.5	1.6
10	2.3	10.8	2.0
20	2.6	12.1	2.6
50	3.3	13.8	3.3
100	3.6	15.1	3.6
		Fall	
5	4.3	14.1	1.6
10	4.9	15.1	2.0
20	5.9	16.4	2.3
50	6.9	17.7	2.6
100	7.5	19.0	3.0

Table A3 - Significant Deep Water Wave Periods at Buffalo, NY

Wave Height	Angle Class 1	Angle Class 2	Angle Class 3
(Feet)	Wave Period (Seconds)	Wave Period (Seconds)	Wave Period (Seconds)
1	2.4	2.3	2.5
2	3.7	3.6	3.8
3	4.7	4.5	4.8
4	5.4	5.2	5.5
5	6.0	5.7	6.1
6	6.4	6.0	6.5
7	6.8	6.3	6.9
8	7.2	6.7	7.3
9	7.6	7.0	7.7
10	8.1	7.3	8.2
11	8.5	7.6	8.6
12	8.9	7.9	9.0
13	9.3	8.3	9.4
14	9.7	8.6	9.8
15	10.1	8.9	10.2
16	10.5	9.2	10.6
17	10.9	9.5	11.0
18	11.3	9.9	11.4
19	11.7	10.2	11.8
20	12.2	10.5	12.3
21	12.6	10.8	12.7
22	13.0	11.1	13.1
23	13.4	11.5	13.5
24	13.8	11.8	13.9
25	14.2	12.1	14.3

entrance into Buffalo Harbor for bulk cargo vessels up to 1,000 feet in length. The entrance plan is designed to create a safe navigation entrance channel from Lake Erie into the Port of Buffalo.

All structural modifications are designed as standard rubblemound structures composed of two underlayers of randomly placed stones, protected with a cover layer of selected armor stone. In accordance with a 4 May 1976 Guidance Letter provided by NCDED-H for use of WES Technical Report H-76-1 entitled "Design Wave Information for the Great Lakes - Report 1 - Lake Erie", a combined 10-year recurrence design maximum lake level and a 20-year recurrence deep water wave will be used as the design conditions for analyzing the stability of structural modifications.

A workshop was held in Cleveland, OH, on 8 April 1981 with vessel masters of 1,000-foot long bulk cargo vessels operating on the Great Lakes. The purpose of the workshop was to obtain information on vessel operating characteristics in order to establish design criteria for safe and efficient entrances to Cleveland Harbor. According to the vessel masters, regardless of the improvements implemented at Cleveland Harbor, they would not attempt to enter Cleveland with 1,000-foot long vessels when winds exceed 30-knots nor when wave heights in the lake approach channel exceed 8.0 feet in height. The vessel masters also stated that modifications to the Cleveland Harbor entrance should be designed to limit wave heights in the entrance channel during design conditions (i.e., 8-foot waves and 30-knot winds) to 2-3 feet thereby allowing the vessel to slow down to 2-3 miles per hour whereby the vessel's side thrusters would become effective for controlling the vessel (NOTE: according to vessel masters, above 2-3 miles per hour, side thrusters lose their effectiveness in controlling a vessel). It is assumed that these entrance criteria are applicable to 1,000-foot long vessels entering the south entrance at Buffalo Harbor. When winds and waves exceed those defined as the entrance criteria, the vessel anchors offshore until the winds and waves diminish such that the vessel can enter the harbor safely. Under the wind and wave conditions defined above, the 1,000-foot long vessel would have to enter into the protected area of the entrance channel traveling at a speed of about 6 miles per hour under design conditions (i.e., 8-foot waves and 30-knot winds), a vessel roll value of 3-5 degrees can be expected on a 1,000-foot long vessel. For determination of required channel depth, a 4-degree value for roll will be used for 1,000-foot long vessels. The vessel masters stated that smaller vessels (vessels 730-foot in length and less) could probably enter under more severe weather conditions than a 1,000-foot long vessel and that the amount of roll would be 1-1/2 times the roll of the 1,000-foot long vessel for the corresponding wave condition, or between 5-7 degrees. For determination of required channel depth, a 6-degree value for roll will be used for vessels less than 1,000 feet in length.

As recommended in DAEN-CWE-HD draft Engineer Technical Letter dated 9 June 1980, entitled "Deep Draft Navigation Project Design", a design water level which is exceeded 95 percent of the time will be utilized in determination of required channel depths.

A6. DESIGN MAXIMUM WATER LEVEL (DWL)

The design maximum water level is a combination of the joint occurrence of long-term average lake level with a short-term rise due to a storm setup. A 10-year recurrence water level will be determined in this design in order to compute the incident wave heights at the structure for designing the size of the armor units required for the structural modifications. The 10-year recurrence water level was determined by combination of the 10-year annual mean lake level of Lake Erie with a 12-month short period fluctuation at Buffalo, NY. The annual mean lake level was obtained from the "Standardized Frequency Curves for Design Water Level Determination on the Great Lakes" prepared by Detroit District in 1979. The short period fluctuation due to a storm setup was obtained from the "Review of Reports on Lake Erie - Lake Ontario Waterway, NY - Appendix C - Hydrology and Hydraulic Design" prepared by Buffalo District in October 1973. The frequency curve for annual mean levels of Lake Erie is shown on Figure A3 and indicates that an annual mean level of approximately 572.7 occurs once in 10 years. Figure A4 presents the frequency curve of short period fluctuation at Buffalo, NY, and indicates that a fluctuation of approximately 4.9 feet can be expected each year. The annual mean level for Lake Erie which has a 10-year recurrence can be combined with the short period fluctuation that has a 1-year recurrence to obtain a 10-year recurrence design maximum water level of elevation 577.6 or 9.0 feet above low water datum.

A7. DESIGN MINIMUM WATER LEVEL

The design minimum water level is used for channel depth evaluation. As recommended in DAEN-CWE-HD draft Engineer Technical Letter dated 9 June 1980, entitled "Deep Draft Navigation project Design", a design water level which is exceeded 95 percent of the time during the navigation season should be used in determination of required channel depths. The water level for this analysis was obtained from the "Standardized Frequency Curves for Design Water Level Determination on the Great Lakes" prepared by Detroit District in 1979. The frequency curve for the fourth quarter mean lake level of Lake Erie (fall season) is shown on Figure A5 and indicates that a mean level of approximately 568.8 or 0.2 feet above low water datum is exceeded 95 percent of the time.

A8. SOUTH ENTRANCE PLAN

On 21 September 1980, personnel from the Buffalo District Corps Office observed the 1,000-foot long "MESABI MINER" as it entered the Buffalo Harbor through the south entrance. After the vessel docked at the Bethlehem Steel Company dock, the District personnel met with the vessel's Captain and 1st Mate to pose questions regarding problems that they experience in entering Buffalo Harbor. The Captain and 1st Mate both felt that most, if not all, of the harbors on the Great Lakes are not designed for 1,000-foot long vessels. They also implied that the experience of the individual vessel master affects the perception of the problem and needs at Federally improved harbors on the Great Lakes. According to the Captain, each entrance and exit is a unique event and cannot be categorized. The Captain stated that there are more problems exiting Buffalo Harbor than when entering because vessels

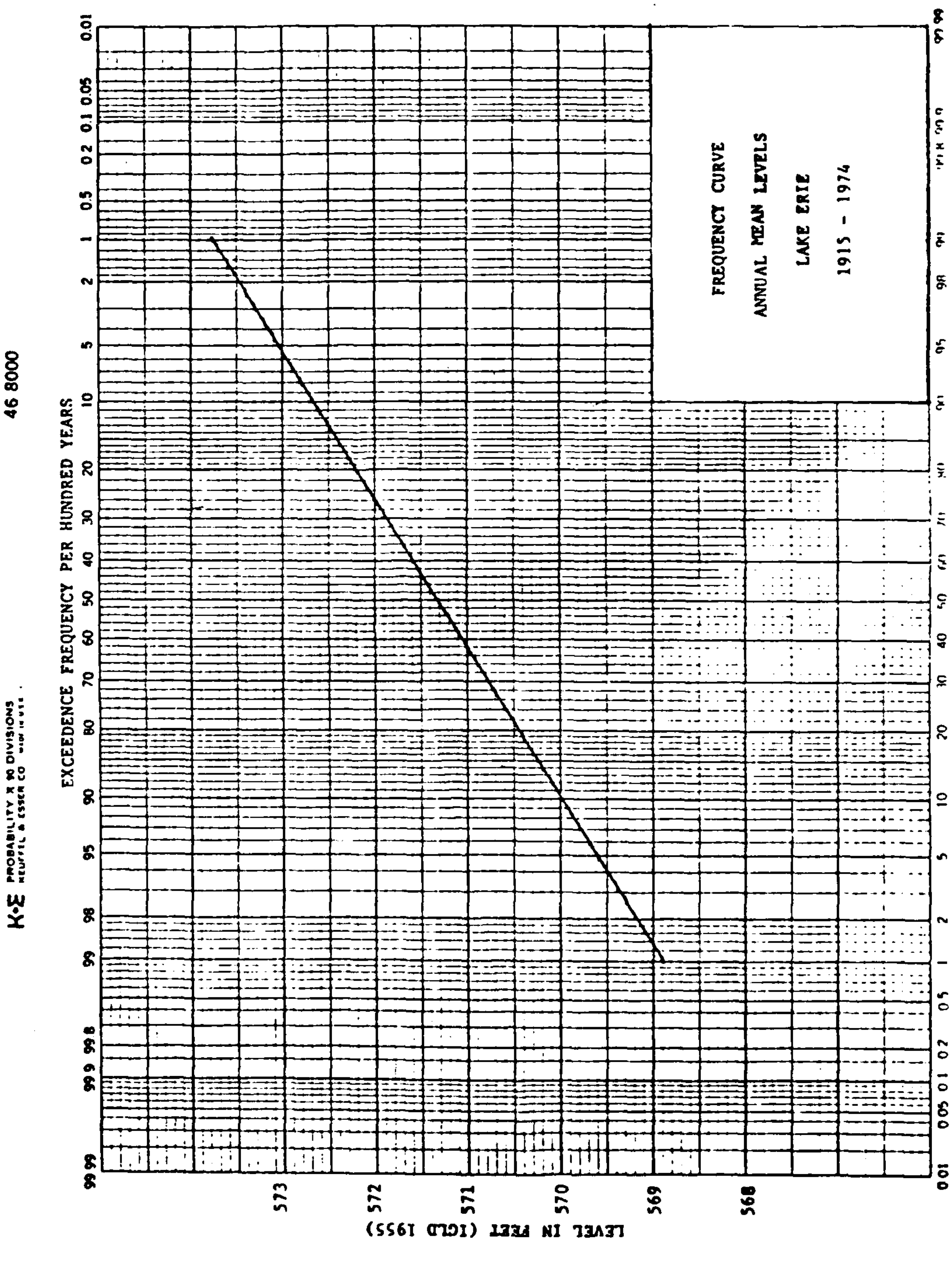

FREQUENCY CURVE
ANNUAL MEAN LEVELS
LAKE ERIE
1915 - 1974
EXCEEDENCE FREQUENCY PER HUNDRED YEARS
LEVEL IN FEET (IGLD 1955)
573
572
571
570
569
568
46 8000
K·E PROBABILITY X 90 DIVISIONS

Figure A3

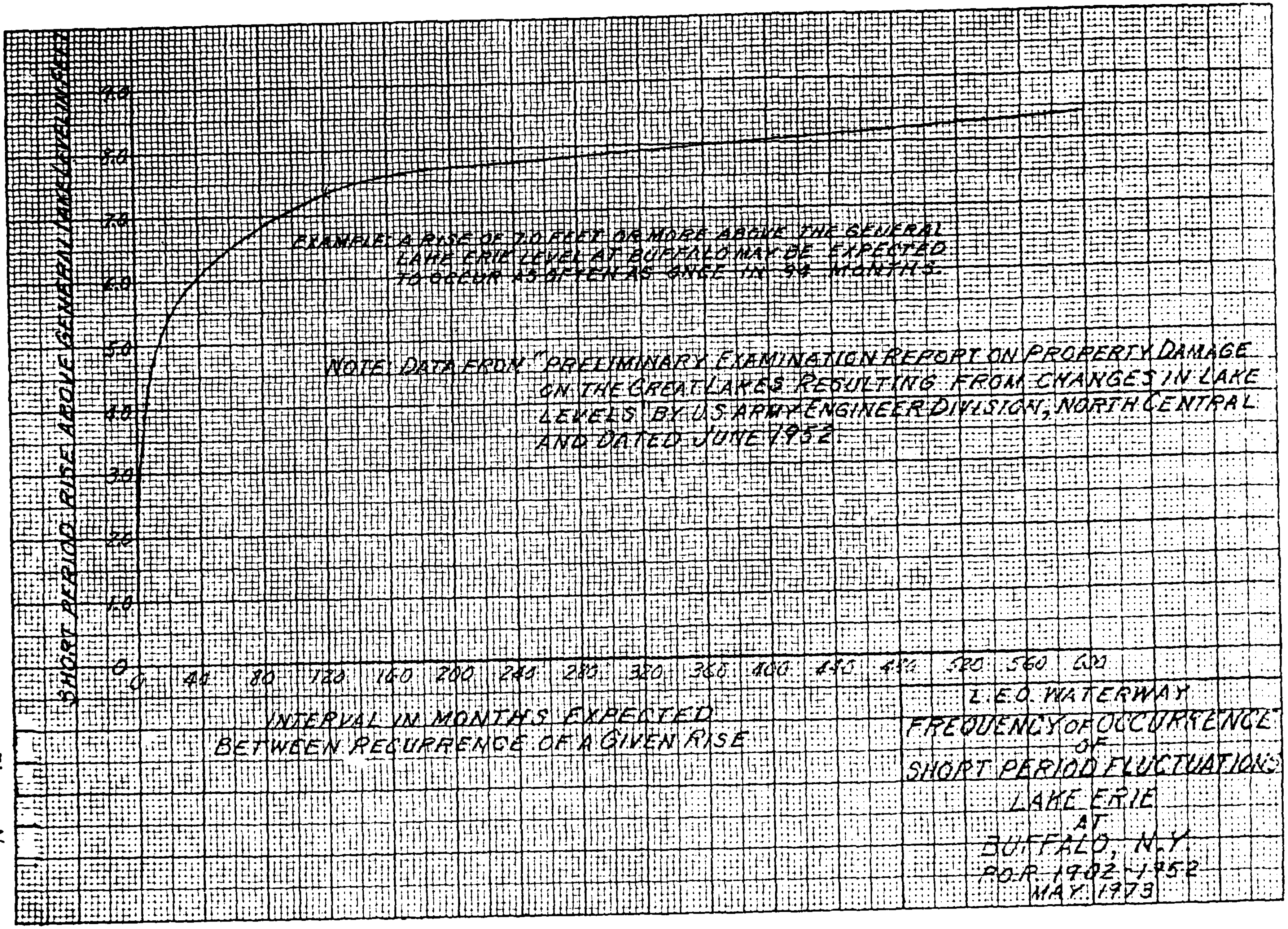

SHORT PERIOD RISE ABOVE GENERAL LAKE LEVEL IN FEET
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0
0
40
80
120
160
200
240
280
320
360
400
560
600
EXAMPLE: A RISE OF 7.0 FEET OR MORE ABOVE THE GENERAL LAKE ERIE LEVEL AT BUFFALO MAY BE EXPECTED TO OCCUR AS OFTEN AS ONCE IN 94 MONTHS.
NOTE: DATA FROM "PRELIMINARY EXAMINATION REPORT ON PROPERTY DAMAGE ON THE GREAT LAKES RESULTING FROM CHANGES IN LAKE LEVELS" BY U.S. ARMY ENGINEER DIVISION, NORTH CENTRAL AND DATED JUNE 1952
INTERVAL IN MONTHS EXPECTED BETWEEN RECURRENCE OF A GIVEN RISE
L.E.O. WATERWAY
FREQUENCY OF OCCURRENCE
OF
SHORT PERIOD FLUCTUATIONS
LAKE ERIE
AT
BUFFALO, N.Y.
P.O.R. 1902-1952
MAY 1973

Figure A4

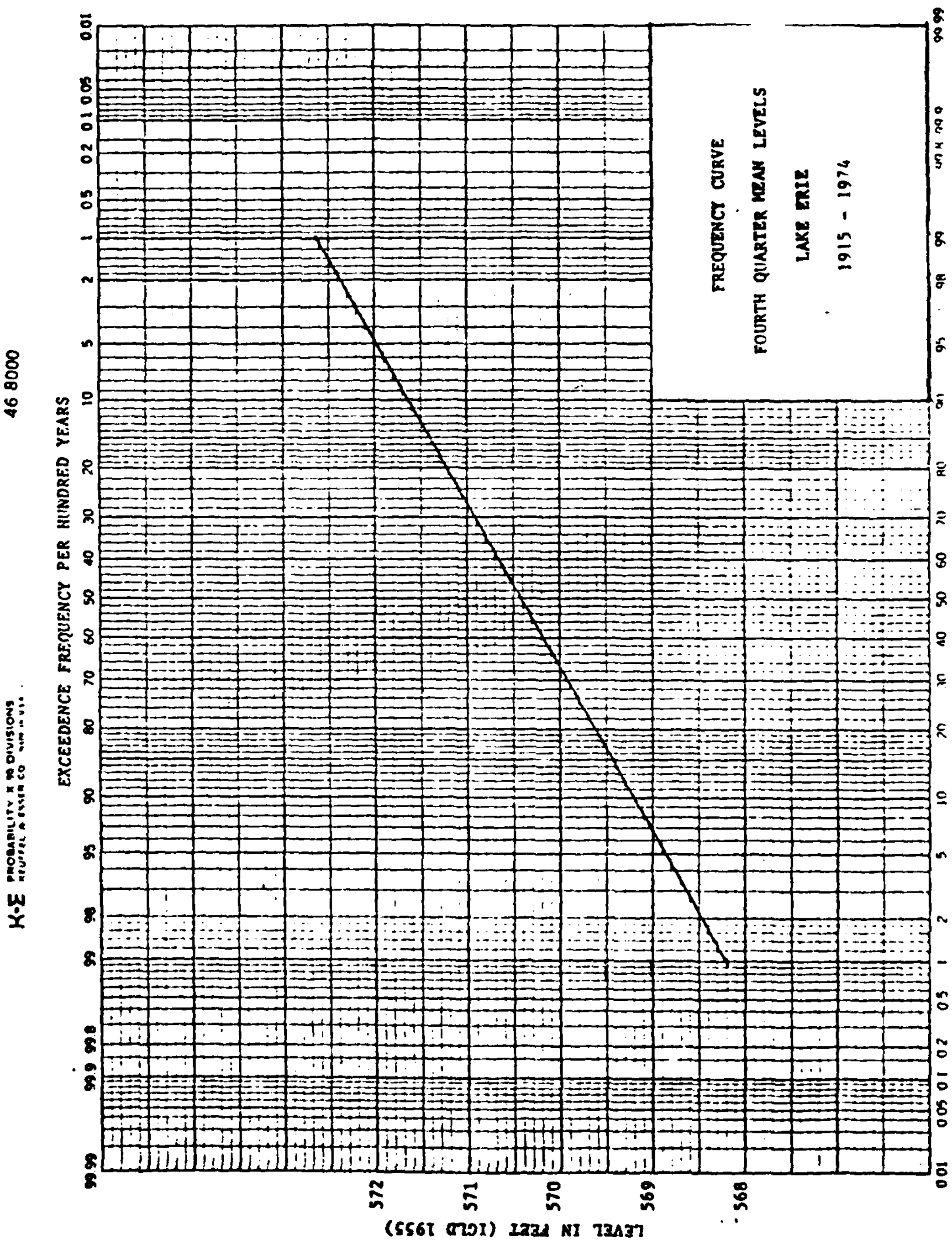

K-E PROBABILITY X 90 DIVISIONS
KEUFFEL & ESSER CO.
46 8000
EXCEEDENCE FREQUENCY PER HUNDRED YEARS
FREQUENCY CURVE
FOURTH QUARTER MEAN LEVELS
LAKE ERIE
1915 - 1974
572
571
570
569
568
LEVEL IN FEET (IGLD 1955)

Figure A5

must back out of the Lackawanna Canal and into the southern Outer Harbor channel and then swing wide of the South Breakwater which does not give them a straight approach through the relatively narrow (500-foot wide) inner end of the south entrance channel. The Captain suggested modifications to the south entrance consisting of a wider entrance (i.e., by removing part of the South Breakwater) along with more depth; lengthening of the South Entrance Arm Breakwater to afford vessels more protection when entering the harbor (depending on the wind direction); and a turning basin to accommodate 1,000-foot long vessels.

Several structural changes would be involved in order to provide for a safe and efficient entrance into the Port of Buffalo through the existing south entrance by bulk cargo vessel up to 1,000 feet in length. The Buffalo District of the Corps of Engineers developed a south entrance concept based on the suggestions of the Captain of the "MESABI MINER." The concept is shown on Plate A4 and entails a new 1,000-foot long breakwater located 1,500 feet north of the existing south end of the South Breakwater, removal of the southernmost 750 feet of the existing South Breakwater, a new 500-foot long breakwater extension on the west end of the existing South Entrance Arm Breakwater, an extension of the existing outer limit of the south entrance channel, approximately 1,000 feet lakeward to the 32-foot depth contour, and deepening of the south entrance channel and southern Outer Harbor channel to 32 feet and 30 feet below low water datum, respectively. The new 1,000-foot long breakwater and the 500-foot long extension on the South Entrance Arm were aligned to provide vessels more protection when entering the harbor. The new breakwater and extension are required so wave heights in the entrance channel will meet the 3-foot criterion for incident waves in the lake approach channel of 8 feet in height and less. The new 1,000-foot long breakwater is aligned perpendicular to the existing South Breakwater in order to provide a protected entrance area during episodes of northwesterly wave attack and to prevent increased wave activity in the Outer Harbor area when the existing South Breakwater is shortened. At the 8 April 1981 workshop (see paragraph A5), the vessel masters indicated that the stopping distance for a 1,000-foot long vessel, traveling at a speed of 6 miles per hour, as required under design conditions, is approximately 1,700 to 1,800 feet after the vessel is completely into the protected entrance area. Therefore, the 500-foot long extension will allow additional distance for a 1,000-foot long vessel to slow down before making the turn into the southern Outer Harbor channel. Removal of 750 feet from the south end of the South Breakwater will provide a wider entrance, which is required for safe and efficient vessel movement in the southern portion of the Outer Harbor. This south entrance concept will require testing and refinement in a hydraulic model investigation of the Outer Harbor by the Corps of Engineers Waterways Experiment Station which would be conducted during a later stage of study (Phase I GDM).

A9. DESIGN STRUCTURE DEPTH (d_s)

Structural modifications for Buffalo Harbor were analyzed at a single location (structure trunk) in the design of a typical breakwater section for use in determining the economic efficiency of navigation improvements. The design structure depth(d_s) of the structure toe for the typical section was determined from soundings obtained from NOAA's Nautical Chart for Buffalo

Harbor (Chart No. 14833). The design structure toe depth was determined at the depth contour at which the longest reach of breakwater would be positioned. Based on the layout of the south entrance plan shown on Plate A4, the 30-foot depth contour was selected for development of the typical section. The depth contour at the structure toe plus the design maximum water level (DWL) minus the low water datum (LWD) elevation equals the design depth of water at the structure toe (d_s). The design structure depth value used in this analysis is as follows:

d_s = depth contour + DWL - LWD
where LWD = 568.6.

d_s = 30.0 + 577.6 - 568.6 = 39.0 feet.

A10. DEEP WATER DESIGN WAVES (H_o).

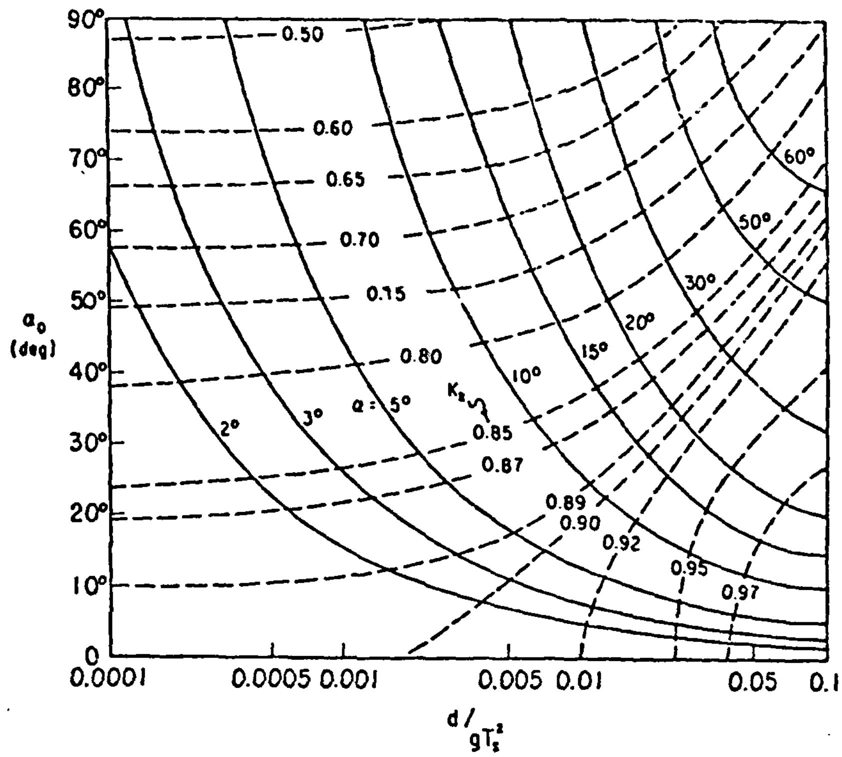
Table A4 summarizes the 20-year recurrence deep water wave heights from Table A2 and associated wave periods from Table A3 which were analyzed to design the size of the armor units required for structural modifications. Table A4 also presents the season during which the deep water wave occurs, the angle class from which the wave propagates, and the design water level.

Table A4 - Summary of Design Deep Water Waves (H_o).

Deep Water Wave Height (H_o) (Feet)	Wave Period (T_o) (Seconds)	Season	Angle Class	Design Water Level
5.9	6.4	Fall	1	EL 577.6 (+9.0 Feet)
17.7	9.8	Winter	2	EL 577.6 (+9.0 Feet)
4.6	5.9	Winter	3	EL 577.6 (+9.0 Feet)

A11. WAVE REFRACTION ANALYSIS

Refraction coefficients (K_r) were calculated using the design curves in Appendix A of Technical Paper No. 80-3 entitled "Estimating Nearshore Conditions for Irregular Waves." The design curves for S* = 4 which relates to wind waves (see Figure A6) were used to compute the refraction coefficients for the dominant wave direction angles (α_o). The refraction coefficient (K_r) is determined by finding the intersection of the deep water wave angles (α_o) on the abscissa with the value of $d/(gT_s^2)$ on the ordinate where d is the nearshore water depth of interest, g is the acceleration due to gravity, and T_s is the wave period. K_r is estimated by interpolation between curves of constant K_r. Table A5 is a summary of the steps followed to determine the refraction coefficients that were used in determination of the design incident wave.



Wave refraction for S* = 4.

d = nearshore water depth of interest
g = acceleration of gravity
T_s = Wave Period
α_o = dominant deep water wave direction angle
α = nearshore wave direction angle
K_R = Wave Refraction Coefficient

Figure A6- Design Curves for Determination of Refraction Coefficients for Wind Generated Waves

Table A5 - Determination of Refraction Coefficients (K_r)

Angle Class	α_o	d	g	T_s	d/gT_s^2	K_r
	(Degrees)	(Feet)	(Feet/Sec^2)	(Seconds		
1	60	39.0	32.2	6.4	0.030	0.78
2	0	39.0	32.2	9.8	0.013	0.93
3	45	39.0	32.2	5.9	0.035	0.86

A12. SHOALING ANALYSIS

The effects of shoaling on reducing wave heights were analyzed to determine the design incident waves at the structures. The design curves from Appendix B of Technical Paper No. 80-3 were used to analyze the waves as they move from deep water into shallower water and to determine the incident wave heights (H_{sig}). The procedure consists essentially of using the appropriate "GODA" curve based on design depth (d_s), unrefracted deep water wave height (H_o'), deep water wave steepness (H_o'/L_o), and lake bottom slope, from which the incident wave height can be determined. Table A6 is a summary of the steps used in conjunction with the "GODA" curves to deduce the incident waves (H_{sig}).

A13. DESIGN INCIDENT WAVE (H_{sig})

The analysis presented in Table A6 shows the largest incident waves (H_{sig}) which will occur at Buffalo Harbor from each direction as a result of the 20-year significant deep water waves superimposed on the 10-year design maximum water level. Based on the results from the analysis in Table A6, the structural modifications at Buffalo Harbor are designed to be stable against the largest incident wave, which in a depth of water of 39.0 feet, is a 16.0-foot nonbreaking wave.

A14. STONE DESIGN

The purpose of this section is to present the design equations, rationale, and specifications for the stone and layer thicknesses for structural modifications at Buffalo Harbor. The structural modifications are designed as standard rubblemound structures. The procedures outlined in Sections 7.373 and 7.377 of the Shore Protection Manual (SPM) were used to determine the structure geometry. The design is based on the use of stone having a density of 160 pounds per cubic foot. A single cross section was developed to illustrate a typical section representative of all structural modifications for use in determination of stone quantities for estimating the project costs. The stone to be used to construct all structural modifications was designed to be stable against the largest design incident wave which is a 16.0-foot nonbreaking wave. The stone design calculations are presented in the computations attached to the end of this appendix.

Table A6 - *Determination of Incident Wave Height* (H_{sig})

Angle Class	H_o	K_r	$H'_o = H_o K_r$	d_s	T_s	$L_o = 5.12\ T_s^2$	H'_o/L_o	d_s/H'_o	Slope	H_{sig}/H'_o	H_{sig}
	(Feet)		(Feet)	(Feet)	(Seconds)						
1	5.9	0.78	4.6	39.0	6.4	209.7	0.022	8.5	0.001	1.00	4.6
2	17.7	0.93	16.5	39.0	9.8	491.7	0.034	2.4	0.001	0.97	16.0
3	4.6	0.86	4.0	39.0	5.9	178.2	0.022	9.8	0.001	1.00	4.0

a. Armor Units.

Armor units were designed by application of Hudson's formula from Section 7.373 of the Shore Protection Manual.

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot \theta}$$

Where:

W = Weight of armor unit in primary cover layer.

w_r = Stone density in pounds/feet^3, assume w_r = 160 pcf.

H = Design incident wave height at structure = 16.0 feet.

K_D = Stability coefficient of the armor layer; use K_D = 4.0 for nonbreaking wave at structure trunk.

S_r = Specific gravity of armor stone = 160/62.4 = 2.56.

Cot 0 = Structure sideslope = 1.5.

The stability coefficient was selected for structures comprising two layers of angular quarry stone randomly placed and subjected to a 16.0-foot nonbreaking wave. The stability coefficient used corresponds to that for a structure trunk section. The armor unit stone size was computed as a range which is a function of W. The limits of the stone size range are as follows:

W_{max} = 2.0W
W_{min} = 0.9W

A range of 0.9W to 2.0W is used to define the minimum and maximum limits for armor stone weight. The range is adequate in size to insure that suppliers can produce the stone economically. Also, the 0.9W is close enough to W to insure that at least 75 percent of the individual armor units as required by the Shore Protection Manual will have a weight greater than W without any further gradation restrictions. Table A7 summarizes the size of the armor units required for all structural modifications at the Port of Buffalo.

b. Underlayer Stone.

The underlayer stone is required to enhance stability and to provide support at the bottom of the armor layer. The underlayer stone size was computed as a range which is a function of W. The limits of the stone size range are as follows:

W_{max} = 0.2W
W_{min} = 0.06 W

Table A7 summarizes the size of the underlayer stone required for all structural modifications at the Port of Buffalo.

c. Bedding Layer and Core Stone.

A bedding layer will be required under the entire base of all structural modifications and will extend 5 feet beyond the underlayer stone to form a toe. The bedding layer will provide a firm foundation and protect the structure against excessive settlement and thereby prevent the underlayer stone and armor units above them from sliding down the slope. The bedding layer is raised in the center of the structure to provide a core which forms a transition between the underlayer stone and bedding layer. The core stone provides the support for the armor and underlayer stone. The bedding and core stone sizes were computed as a range which is a function of W. The limits of the stone range are as follows:

$W_{max} = 0.01W$
$W_{min} = 0.00015W$

Table A7 summarizes the size of the bedding and core stone required for all structural modifications at the Port of Buffalo.

A15. CREST ELEVATION

Overtopping of rubblemound structures can be tolerated only if it does not cause damaging waves behind the structures. Whether overtopping will occur depends on the height of the crest of the structure relative to wave runup which depends on wave characteristics, structure slope, porosity, and roughness of the cover layer. The crest elevation of rubblemound structures is designed for the lowest height that provides the protection required and thereby keeps the construction and maintenance costs at a minimum (see paragraph A5). It is assumed that the Cleveland Harbor entrance criteria are applicable to 1,000-foot long vessels entering the south entrance at Buffalo Harbor. Therefore, the structural modifications for Buffalo Harbor are designed to allow a maximum transmitted wave of 3 feet in the entrance channel.

The 3-foot maximum interior wave is of concern during the navigation season only (spring through fall season), therefore, an analysis was undertaken to determine the significant deep water waves that would create an 8-foot incident wave at the entrance. The analysis was undertaken for waves from only angle Class 2 because deep water waves of 8-feet in height from angle Classes 1 and 3 are infrequent having recurrence periods of over 100 years. The resulting significant deep water wave that creates an 8-foot incident wave was compared to the waves presented in Table A2 to assure that the 8-foot wave can occur during the navigation season. The 8-foot wave was assumed to be the maximum wave in the lake approach channel at which vessel masters would enter Buffalo Harbor. The analysis (see computations attached to the end of this appendix) shows that a 9.0-foot, 7.0 second significant deep water wave from angle Class 2 is required to yield an 8-foot indicent wave at the entrance.

Comparison of the calculated significant deep water wave required to yield the 8-foot incident wave with those determined by Waterways Experiment Station (see Table A2) indicates that the computed wave from angle Class 2

has a recurrence interval of less than 5 years during the spring, summer, and fall seasons, when superimposed on the 10-year recurrence maximum design water level. Therefore, the angle Class 2 wave (9.0-feet, 7.0 seconds) was used in the analysis to determine the transmitted wave in the entrance channel due to overtopping.

The structural modifications at Buffalo Harbor are designed as rough permeable structures. Therefore, wave transmission in the lee of the structures may occur due to some wave energy being passed through the structure and due to wave overtopping when wave runup exceeds the crest elevation of the structures. This design assumes that wave transmission through the structure is negligible and that waves regenerated in the lee of the structure will be caused only by overtopping of the structures. The majority of the existing breakwaters at Buffalo Harbor are constructed to a crest elevation 583.1 (14.5 feet above low water datum), therefore, the new structural modifications will be consistent with the crest elevation of the existing breakwaters. An estimation of the wave heights transmitted in the lee of the structural modifications having a crest elevation of 14.5 feet above low water datum was analyzed using the method provided in CETA 79-6 entitled "Estimation of Wave Transmission Coefficients for Permeable Breakwaters," and TR-80-1 entitled "Two Dimensional Tests of Wave Transmission and Reflection Characteristics of Laboratory Breakwaters." The results from the transmitted wave analysis indicate that the criterion for a regenerated wave with a maximum height of 3-feet in the entrance channel during the navigation season is satisfied for the condition of an 8-foot incident wave at the entrance. The wave which will be regenerated in the entrance channel due to wave overtopping of the structural modifications will be approximatley 1-foot. The computations for determining the transmitted wave height are presented in the calculations attached to the end of this appendix.

Based on the results from the transmitted wave analysis, the crest elevation of the structural modifications can be less than the 14.5 feet above low water datum crest elevation of the existing structures to satisfy the 2 to 3 foot-wave height criterion in the entrance channel during the navigation season. However, in order not to increase the wave activity inside the southern Outer Harbor channel, over those which occur for existing conditions during episodes of more severe wave activity in the lake, the 14.5 feet above low water datum crest elevation will be maintained on all structural modifications.

A16. CREST WIDTH

The width of the crest of the structural modifications depend upon the degree of allowable wave overtopping. The amount of allowable overtopping was previously discussed as that which would regenerate a maximum 3-foot wave in the entrance channel. As a general guide for overtopping conditions, the minimum crest width should equal the combined widths of three armor units. Therefore, the method precented in Section 7.377 of the Shore Protection Manual requires that the minimum crest width be equal to the combined widths of three armor units. The crest width was computed by:

$$B = nk_{\Delta}\left(\frac{W}{W_r}\right)^{1/3}$$

Where:

B = Crest width (feet).

n = Number of stones in crest width = 3.

k_Δ = Layer coefficient = 1.15 for two layers of randomly placed rough quarry stone.

W = Weight of individual armor stone.

W_r = Stone density, assume W_r = 160 pound/feet^3

The crest width computation is presented in the calculations attached to the end of this appendix and indicates that a crest width of 19.5 feet is required.

A17. DESIGN SECTION

The typical design cross section for all structural modifications at Buffalo Harbor is shown on Plate A5. The section is typical for the entire length of the structures. A 1.0 vertical on 1.5 horizontal sideslope is used on both the lake side and channel side of the structures. The rubblemound cross section is designed to be stable against a 16.0-foot nonbreaking wave (H_{sig}) and the bottom elevation of the armor unit layer is extended downslope to an elevation below the design minimum water level equal to 1.5 H_{sig}. The thickness of the armor layer and underlayer was determined by:

$$r = nk_\Delta \left(\frac{W}{W_r} \right)^{1/3}$$

Where:

r = Average layer thickness (feet).

n = Number of stones in thickness comprising the cover layer; use n = 2.

k_Δ = Layer coefficient = 1.15 for two layers of randomly placed rough quarry stone.

W = Weight of an individual armor stone in the cover layer (for determining thickness of armor layer).

W_{10} = One-tenth the weight of an individual armor stone in cover layer (W = .1W for determining thickness of the underlayer).

W_r = Stone density, assume 160 pcf.

The computations for determining the dimensions for the design section are presented in the calculations attached to the end of this appendix.

Table A7 - Summary of Structure Parameters for South Entrance Plan

	Armor Stone		Underlayer Stone		Bedding/Core Stone	
	Maximum (Tons)	Minimum (Tons)	Maximum (Tons)	Maximum (Tons)	Minimum (Pounds)	Maximum (Pounds
All New Structures	29.0	13.0	3.0	1.0	300	4

	Crest Width (Feet)	Armor Layer Thickness (Feet)	Underlayer Thickness (Feet)	Crest Height
All New Structures	19.5	13.0	6.0	EL 583.1 (+14.5 LWD)

A18. WAVE DIFFRACTION ANALYSIS

A wave diffraction study was undertaken to determine if the plan shown on Plate A4 will provide adequate wave protection for vessels up to 1,000 feet in length. According to the vessel masters, wave heights in the entrance channel during design conditions (i.e., 8-foot waves and 30-knot winds) should be limited to 2-3 feet to allow the vessel to slow down whereby the vessel's side thrusters would become effective in controlling the vessel. Therefore, diffraction analyses were performed to calculate wave heights within the entrance channel. The actual breakwater configuration is not a true gap, however, it is assumed that the rubblemound breakwaters would be efficient wave dissipators, thereby allowing this type of analysis. The diffraction analysis considered only angle Class 2 wave approach directions since it was determined (see Paragraph A15) that 8-foot waves in the lake approach channel (maximum height for which vessels would enter) during the navigation season will occur most frequently from the south-southwest through west directions (angle Class 2).

Diffraction diagrams, assuming end and gap diffraction, were constructed for direct incoming (angle Class 2) waves which have a height of 8 feet and period of 7 seconds at the entrance. The direction of wave propagation used was due west (270 degrees) which is the boundary between angle Class 1 and angle Class 2 waves. Figure 2-28 in the Shore Protection Manual was utilized to construct the diffraction diagram resulting from end diffraction and Figure 2-49 was utilized to construct the diffraction diagram resulting from gap diffraction. The condition shown in the diffraction diagrams for the due west direction would be the most severe angle of wave approach for which the 8-foot wave at the entrance occurs during the navigation season. The diffraction diagrams are shown on Figures A7 and A8 and the diffraction coefficients on the diagrams indicate that wave heights in the entrance channel would exceed the 3-foot height required for entrance of the harbor under design conditions and for this wave approach condition.

Another diffraction analysis was undertaken to determine the wave conditions in the entrance channel when 8-foot incident waves approach from a southwesterly direction (angle Class 2) and diffract around the end of the new south entrance arm breakwater extension. Figure 2-31 in the Shore Protection Manual was utilized to construct the diffraction diagram resulting from end diffraction. The diffraction diagram is shown on Figure A9 and the diffraction coefficients on the diagram indicate that wave heights in the entrance channel would be less than the 3 feet required for entrance of the harbor under design conditions and for this wave approach condition.

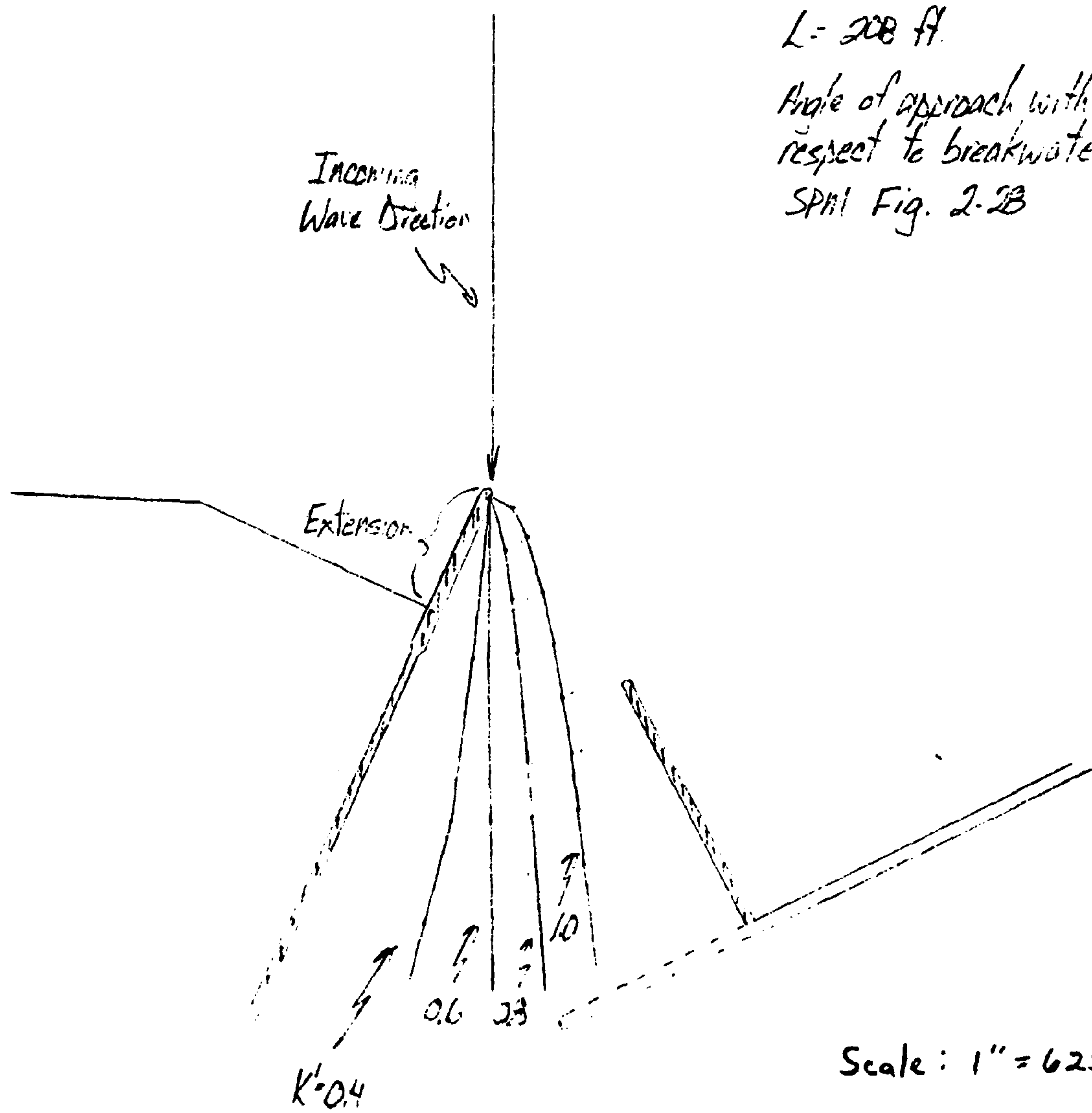
Comparison of the results from the diffraction analyses shown on the diagrams in Figures A7 through A9 indicate that waves in the entrance channel increase as the wave approach direction shifts from the southwest toward the west. The span of wave approach directions for which the 3-foot wave height criteria in the entrance channel is exceeded for an 8-foot incident wave is assumed to be small in comparison to the entire angle Class 2 range. Therefore, alignment of the structural modifications at the south entrance are assumed to provide a safe and efficient entrance into the Outer Harbor of the Port of Buffalo. A model study will be utilized during a later stage of

BY TJE DATE [illegible] SUBJECT Buffalo Harbor, N.Y. SHEET NO. ...... OF ......
CHKD. BY ...... DATE ...... JOB NO. ......

Diffraction Analysis
Buffalo Harbor S. Entrance

End Diffraction

$d = 39$ ft.
$T_o = 7.0$ secs.
$L_o = 251$ ft.
$H_{\text{channel entrance}} = 8.0$ ft.
$L = 208$ ft.
Angle of approach with respect to breakwater $= 15°$
SPM Fig. 2-28



Scale: 1" = 625'

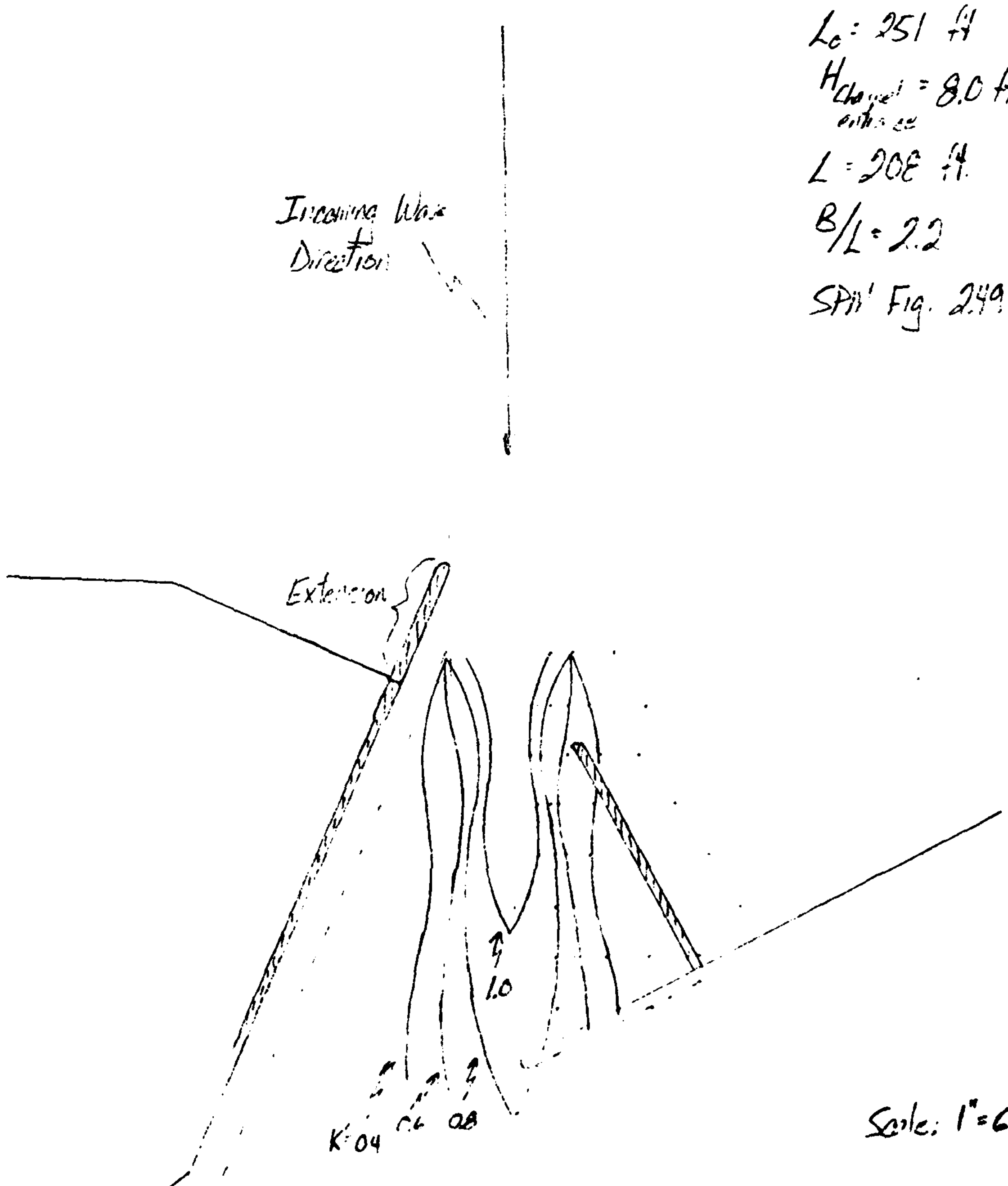
Figure A7 - Diffraction Diagram for Direct Incoming Navigation Season Wave (End Diffraction)

BY TJL DATE 4/8/83 SUBJECT Buffalo Harbor, NY SHEET NO. .... OF ....
CHKD. BY .... DATE .... JOB NO. ....

Diffraction Analysis
Buffalo Harbor S. Entrance

Gap Diffraction

B = 460 ft
d = 39 ft.
T_o = 7.0 secs
L_o = 251 ft
$H_{channel\ entrance}$ = 8.0 ft.
L = 208 ft.
B/L = 2.2
SPM Fig. 2-49 (B/L = 2.5



Scale: 1" = 625'

Figure A8 - Diffraction Diagram for Direct Incoming Navigation Season Wave (Gap Diffraction)

BY Ltk DATE 4/ /89 SUBJECT Buffalo Harbor, NY SHEET NO. .... OF ....
CHKD. BY .... DATE .... JOB NO. ....

Diffraction Analysis
Buffalo Harbor S. Entrance

End Diffraction
$d = 39$ ft.
$T_o = 7.0$ secs.
$L_o = 251$ ft
$H_{\text{CHANNEL ENTRANCE}} = 8.0$ ft.
$L = 208$ ft.
Angle of approach with respect to breakwater = 60°
Still Fig. 2-31

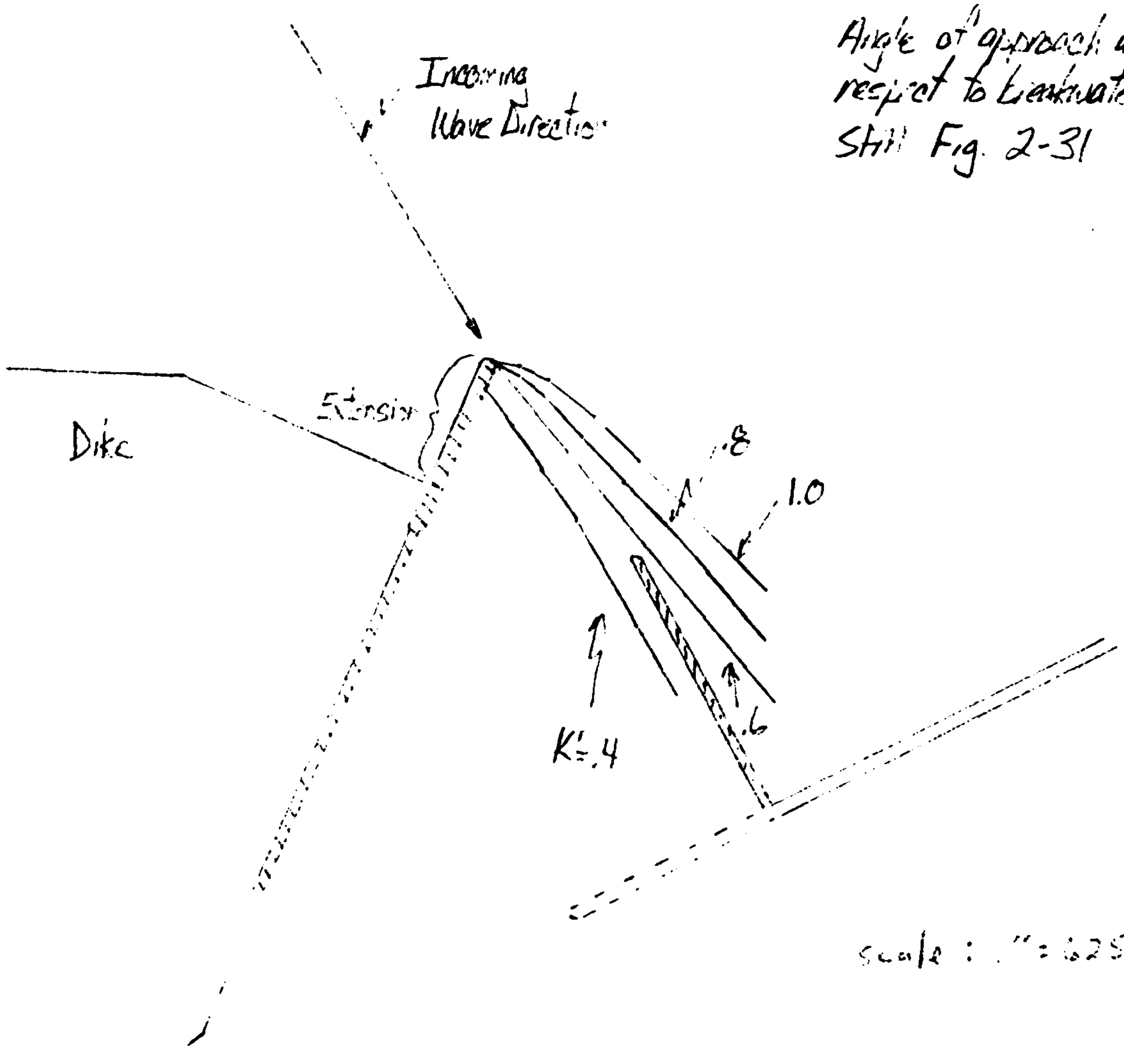


Figure A9 - Diffraction Diagram for Navigation Season Wave from Southwest (End Diffraction Condition)

this study to determine the actual breakwater configuration which is required to satisfy the wave height criterion for entering the harbor.

DETAILED CHANNEL DESIGN

A19. GENERAL

Adequate channel depths and widths are required for safe and efficient navigation of ships. Therefore, at the 8 April 1981 workshop in Cleveland, vessel masters were requested to provide their professional and expert views on 1,000-foot long vessel operating characteristics that are required for the design of an "all-weather" west entrance at Cleveland Harbor. According to the vessel masters, when entering Cleveland Harbor under design "all-weather" conditions (i.e., 8-foot waves and 30-knot winds), a 1,000-foot long vessel would have to be traveling at a speed of approximately 6 miles per hour in order to maintain proper vessel control. Once in the protected entrance channel, the vessel would slow down to 2 to 3 miles per hour before turning into the Lakefront Harbor. When entering at a speed of 6 miles per hour under the design conditions, an angle of roll of 3 to 5 degrees can be expected on a 1,000-foot long vessel. The vessel masters also indicated that the angle of roll for smaller vessels would be about 1-1/2 times the angle of roll of a 1,000-foot long vessel, or between 5 to 7 degrees. The vessel masters also stated that they need sufficient water under their vessel in order to be able to use their engines without rupturing oil and air lines due to excessive vibration of the vessel. These vessel operating characteristics are assumed to be applicable to vessels entering the north and south entrances to Buffalo Harbor.

This section will address the depth and width requirements which are needed to allow: vessels up to 1,000-feet (Class 10) in length to safely enter the south entrance; vessels up to 630 feet (Class 5) in length to safely enter the north entrance; vessels up to 1,000 feet (Class 10) in length to maneuver in the southern and middle Outer Harbor channels; and vessels up to 630 feet (Class 5) in length to navigate through the entire length of Outer Harbor channels. The south entrance channel is designed to accommodate one-way traffic through the south entrance, whereas the north entrance and Outer Harbor channels are designed to accommodate two-way traffic.

A20. CHANNEL DESIGN

a. Channel Depth.

The design minimum water level of 568.8 which represents a lake level which is exceeded 95 percent of the time during the navigation season, will be used for channel depth evaluation and will allow for safe design vessel passage under most conditions. The channel depth requirements will include consideration of the following significant criteria:

(1) The static draft of the vessel at rest;

(2) The sinkage or squat of the vessel underway;

(3) The amount of vessel roll;

(4) The effect of vessel pitch and heave; and

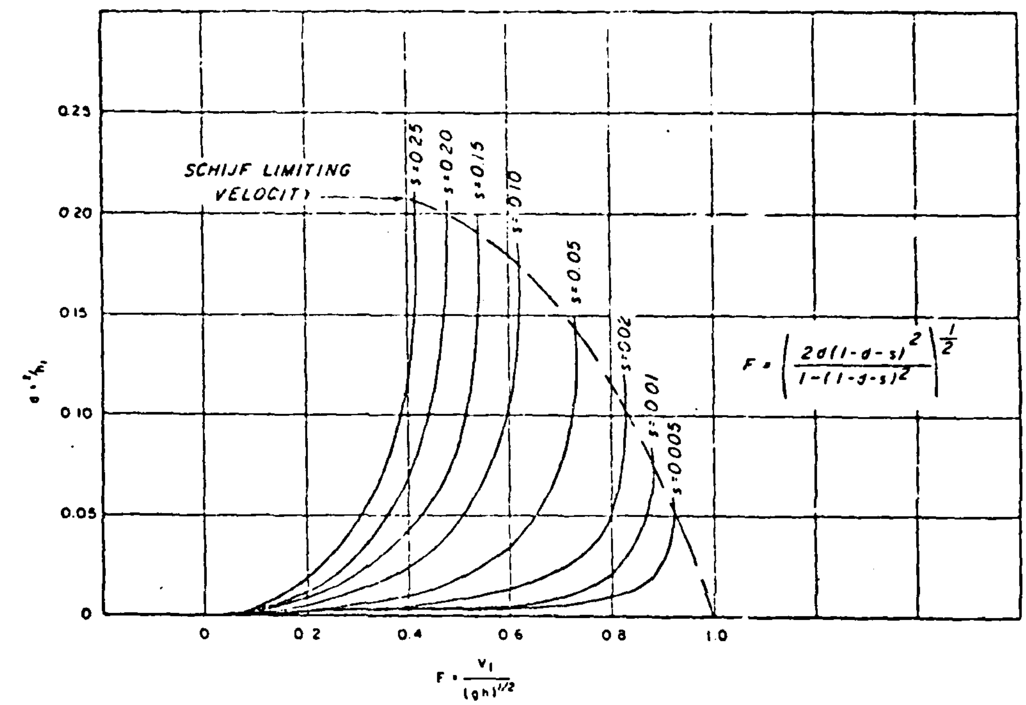
(5) Nominal bottom clearance.

The channel depths were selected to safely and efficiently accommodate the passage of the design vessel which is normally the largest vessel (length, beam, and draft) expected to use the channel during the project life. At Buffalo Harbor, the largest vessel expected to use the south entrance is the Class 10 (1,000 feet X 105 feet) bulk cargo vessel whereas the largest vessel expected to use the north entrance is the Class 5 (600-649 feet X 68 feet) bulk cargo vessel. The combined effect of roll and squat for smaller vessels can be greater than for larger vessels and if loaded drafts are identical, the channel depth requirements may be based upon criteria for the smaller Great Lakes vessels. Therefore the channel depth requirement for the south entrance was evaluated for the Class 5 vessel (600-649 feet X 68 feet), the Class 6 vessel (650-699 feet X 72 feet), the Class 7 vessel (700-730 feet X 75 feet), the Class 8 vessel (731-849 feet X 70 feet), and the Class 10 vessel (950-1,000 feet X 105 feet). The channel depth requirement for the north entrance and north Outer Harbor channels were evaluated for the Class 5 vessel. In the south and middle Outer Harbor channels, the Class 10 vessel was used to evaluate the channel depth requirement. The numerical calculations of the required depths were developed from practical and theoretical information in technical reports and papers. The calculations are attached to the end of this appendix and are based on a 25.5-foot design system draft. The following paragraphs discuss the significant criteria which were considered in determining the required channel depths. The results of the channel depth evaluation are summarized in Table A8. The depth requirements include the greater of the values for either vessel roll or the combination of pitch and heave. A design system draft of 22.5 feet was also considered for several study alternatives and the required channel depth can be obtained by subtracting 3.0 feet from the required depths presented in Table A8 which are those needed for the 25.5 system draft.

(1) Vessel Squat - Vessel squat is the lowering of the water surface around a moving vessel which produces a relative change in the ship's position with respect to the channel bottom. Vessel squat was calculated on the basis of procedures outlined in Chapter 9 of the draft Engineer Manual (EM 1110-2-xxxx) entitled "Deep Draft Navigation Project Design" dated December 1979 (see Figure A10) and also by an empirical method recommended in the "Study Report of Vessel Clearance Criteria for the Great Lakes Connecting Channels" prepared by Detroit District, Corps of Engineers using the following formula:

$$S = \frac{V_i^2}{2g}\left[\left(1.01\,\frac{A_i}{A_w}\right)^2 - 0.84\right]$$

Where: S = Squat at speed V_i (feet).
V_i = Ship velocity (feet/second) relative to water.
A_i = Channel cross-sectional area (square feet).
A_w = Channel cross-sectional area less ship cross-sectional area (square feet).
g = 32.2 feet/second.



Dimensionless squat as a function of the Froude number

$S = \frac{A}{WH}$ where

S = ratio of ship cross section to channel cross section
A = vessel cross sectional area
W = channel width
H = channel water depth

$F = \frac{V}{\sqrt{gh}}$ where

F = the Froude Number
V = speed of the ship relative to the water
g = acceleration of gravity
h = depth of water in the channel

Figure A10

Pertinent parameters include: static draft of 25.5 feet, vessel beam widths, entrance speed at 6 mph, reduced speed of 3 mph, waterway width, and channel depth (assumed). The computed squat values are 0.5 foot for the 1,000-foot long vessel and 0.4-foot for the smaller class vessels in the north and south entrance channels and 0.1 foot for all vessels in the Outer Harbor channels.

(2) Vessel Roll - Vessel roll is rotation of a vessel around its longitudinal axis as a result of waves, wind, and turn angle. Roll is greatest when the vessel hull is parallel to the wave crests. According to vessel masters, an angle of roll in the entrance channels of between 3 and 5 degrees can be expected on the Class 10 vessel and 1-1/2 times that amount (5 to 7 degrees) for smaller vessels. This analysis will use an angle of 4 degrees of roll for the Class 10 vessel and an angle of 6 degrees of roll for Class 5 through Class 8 vessels in the entrance channels. Vessels would not experience any roll once they get into the middle Outer Harbor channel which is behind the South Breakwater. However, a 1,000-foot long vessel can be expected to roll up to 2 to 3 degrees in the southern Outer Harbor channel as a result of waves entering between the breakwaters and as the vessel turns. Smaller vessels can be expected to roll approximately 1-1/2 times the amount of the 1,000-foot long vessel or between 3 to 5 degrees in the south Outer Harbor channel due to waves and turning. Class 5 vessels which utilize the Outer Harbor channels in entering and leaving the Buffalo River can be expected to experience between 3 to 5 degrees of roll in the north Outer Harbor channel due to turning and waves which enter the channel through the gap between existing breakwaters. For study plans which consider vessels using the north entrance channel, an angle of roll of between 5 to 7 degrees can be expected on Class 5 vessels in the north Outer Harbor channel. This analysis will use an angle of 2-1/2 degrees of roll for the 1,000-foot long vessel and an angle of 4 degrees of roll for smaller class vessels in the southern Outer Harbor channel. An angle of 4 degrees of roll will be used in the north Outer Harbor channel for study plans which utilize the Outer Harbor channels to navigate the Buffalo River whereas an angle of 6 degrees of roll will be used in the north Outer Harbor channel for study plans which consider the use of the north entrance channel to enter Buffalo Harbor. The following formula is used to compute vessel roll:

$$Y = \frac{B}{2} \text{ sine } \theta$$

Where: Y = Depth requirement due to roll (feet)
B = Vessel beam
θ = Angle of roll in degrees

The computed roll values in the entrance channels were 3.7 feet for the 1,000-foot long vessel and ranged from 3.6 feet to 3.9 feet for the smaller class vessels. In the south Outer Harbor channel, the computed roll values were 2.3 feet for 1,000-foot long vessels and 2.4 feet for smaller class vessels. In the north Outer Harbor channel, the computed roll values were 2.4 feet and 3.6 feet.

(3) Vessel Pitch and Heave - Vessel pitch is rotation of a vessel about its transverse axis and heave is the vertical body motion of a vessel.

These motions are caused by waves and are greatest when a vessel hull is normal to wave crests. The equations presented in the "Study Report of Vessel Clearance Criteria for the Great Lakes Connecting Channels" prepared by Detroit District of the Corps of Engineers were used to compute the depth requirement due to pitch and heave. These equationa are as follows:

$$\frac{\theta L}{2} = 0.1\ H$$

and

$$\frac{\text{Heave}}{H} = 0.1$$

Where:

$\frac{\theta L}{2}$ - Pitch amplitude in feet

H = Wave amplitude in feet

The pitch and heave value in the north and south entrance channels were determined to be 1.6 feet for each class vessel. Pitch and heave will not be experienced by any class of vessel in the Outer Harbor channels. However, the maximum values of roll, or pitch and heave are not additive since their occurrence is a function of hull and wave crest orientation (i.e., if the vessel hull is parallel to the wave crest, roll is maximum and pitch and heave approach zero). Therefore, the larger of the values of roll, or pitch and heave are used in determining the required channel depth. For entrance plans at Buffalo, the depth requirements for roll govern over the values for pitch and heave.

(4) Nominal Bottom Clearance - After all depth requirements are made for vessel squat, roll, and pitch and heave, it is desirable to design for additional bottom clearance for vessel safety and efficiency. The common allowances for bottom clearance are 2 feet in soft material and 3 feet in hard material. At the south entrance to Buffalo Harbor and through the southern and middle Outer Harbor channels, all material is considered to be soft and, therefore, a nominal bottom clearance value of 2 feet is included in the channel depth requirement. However, in the north entrance channel to Buffalo Harbor and in the northern Outer Harbor channel, the bottom is rock and, therefore, a nominal bottom clearance value of 3 feet is included in the channel depth requirement.

b. Channel Width - The width of the navigation channel is measured at the bottom of the channel that is required for safe navigation of the design vessel. The design vessel for determining the required width of the south entrance channel and the southern and middle Outer Harbor channels for Buffalo Harbor will be the class 10 (950-1,000 feet X 105 feet) bulk cargo vessel. The design vessel for determining the required width of the north entrance channel for Buffalo Harbor and northern Outer Harbor channel will be the Class 5 (600-649 feet X 68 feet) vessel. Some of the factors that will

Table A8 - Summary of Channel Depth Requirements at Buffalo Harbor

Vessel Class	Static Draft (Feet)	Squat Requirement (Feet)	Roll Requirement (Feet)	Pitch and Heave Requirement (Feet)	Nominal Bottom Clearance	Required Channel Depth (1)	Design Minimum Water Level	Channel Bottom Below LWD
South Entrance Channel								
10	25.5	0.5	3.7	1.6	2.0	31.7	568.8	31.5
8	25.5	0.4	3.7	1.6	2.0	31.6	568.8	31.4
7	25.5	0.4	3.9	1.6	2.0	31.8	568.8	31.6
6	25.5	0.4	3.8	1.6	2.0	31.7	568.8	31.5
5	25.5	0.4	3.6	1.6	2.0	31.5	568.8	31.3
North Entrance Channel								
5	25.5	0.4	3.6	1.6	3.0	32.5	568.8	32.3
South Outer Harbor Channel								
10	25.5	0.1	2.3	0.0	2.0	29.9	568.8	29.7
Middle Outer Harbor Channel								
10	25.5	0.1	0.0	0.0	2.0	27.6	568.8	27.4
North Outer Harbor								
5	25.5	0.1	2.4	0.0	3.0	31.0	568.8	30.8 (2)
5	25.5	0.4	3.6	0.0	3.0	32.5	568.8	32.3 (3)

(1) Does not include the Pitch and Heave Requirement since the Roll Requirement is greater.
(2) For study plans which consider that vessels utilize the Outer Harbor channels to enter the Buffalo River.
(3) For study plans which consider vessels using the north entrance channel to enter Buffalo Harbor.

be given consideration in detemining the proper width of the channel are: whether the design vessel must pass another vessel; the controllability of the vessel; the normal speeds of the vessel relative to the channel bottom; current velocities and directions; wave action or wind that will cause the vessel to yaw; the depth of water under the keel of the vessel; whether the channel occupies the entire waterway or is in a wide waterway; and the characteristics of the banks of the channel. The guidance presented in Chapter 10 of the draft Engineer Manual (EM 1110-2-xxxx) entitled "Deep Draft Navigation Project Design" dated December 1979 was used in the channel width evaluation for Buffalo Harbor. Since the length of the entrance channel comprising the south entrance plan is only about 4,000 feet long, the channel is designed to accommodate one-way traffic. The 1.5 mile long north entrance channel and 4.0 mile long Outer Harbor channel are designed to accomoodate passing vessels. The required widths for the north entrance channel and Outer Harbor channels are determined by computing the widths of two maneuvering lanes, a ship clearance lane, and two bank clearance lanes for the design vessels. The required channel width for the south entrance channel was determined by computing the widths of a maneuvering lane and two bank clearance lanes for the design vessel. The minimum required width for each channel is summarized in Table A9.

(1) Maneuvering Lane. The maneuvering lane is defined as that portion of the channel within which the ship may maneuver without encroaching on the channel bank or without approaching another ship or entrance structure so closely that dangerous interference between ships or structures will occur. The recommended minimum maneuvering lane width is 160 percent of the beam of the design vessel for a vessel which experiences no yawing forces and which has good controllability. In the case of Buffalo Harbor, a vessel, entering under the design entrance condition (i.e., 8.0-foot waves and 30-knot winds), will experience yawing forces due to the winds and waves which, in turn, will affect the movement and controllability of the ship. Therefore, for the north and south entrance channels, a maneuvering lane width equivalent to 200 percent of the beam of the design vessel will be incorporated. For the south entrance channel, the design vessel is Class 10 (1,000 feet X 105 feet) and the minimum width of the maneuvering lane will be 210 feet. The Class 5 (630 feet X 68 feet) is the design vessel for the north entrance channel and the minimum width of each maneuvering lane is 140 feet.

Once in the protected area behind the South Breakwater, the controllability of the vessels will be improved. Yawing forces will be reduced with only the winds acting on the side of the vessel. Therefore, a maneuvering lane equivalent to 180 percent of the beam of the design vessel will be incorporated in the Outer Harbor channels. In the southern and middle Outer Harbor channels, the design vessel is Class 10 (1,000 feet X 105 feet) and the minimum width of each maneuvering lane is 190 feet. For the northern Outer Harbor channel, the design vessel is Class 5 (630 feet X 68 feet) and the minimum width of each maneuvering lane is about 125 feet.

(2) Ship Clearance Lane. Where channels are required to accommodate two-way traffic, a ship clearance lane must be provided between the two maneuvering lanes. The recommended minimum width of the ship clearance lane is 80 percent of the beam of the design vessel for a vessel which experiences

no yawing forces. Vessels using the north entrance into Buffalo Harbor will be subjected to yawing forces under the design entrance conditions. Therefore, a ship clearance lane equal to 100 percent of the beam of the design vessel, or about 70 feet, will be used as the minimum width for this lane in the north entrance channel. The south entrance channel is designed to accommodate one-way traffic, therefore, a ship clearance lane is not provided. Once a vessel is in the Outer Harbor channels, the yawing forces will be reduced and a ship clearance lane equivalent to 90 percent of the beam of the design vessel will be used as the minimum width for this lane. In the southern and middle Outer Harbor channels, the Class 10 vessel is the design vessel and the minimum width of the ship clearance lane is about 95 feet. The Class 5 vessel is the design vessel in the northern Outer Harbor channel and the minimum width is about 60 feet.

(3) Bank Clearance Lane - The bank clearance lane is the horizontal distance between the outer boundary of the maneuvering lane and the bottom of the channel sideslope. The recommended minimum width of the bank clearance lane is 60 percent of the beam of the design vessel for vessels with very good controllability in channels where there are no yawing forces. Vessels utilizing the south entrance channel are expected to experience yawing forces under the design entrance conditions, however, the adjacent bank material is soft. Therefore, the minimum width of each bank clearance lane through the south entrance channel will be equal to 150 percent of the beam of the design vessel (Class 10) or about 160 feet. Vessels using the north entrance channel will also experience yawing forces and the bottom material beyond the banks is rock. Therefore, each bank clearance lane through the north entrance channel will be equivalent to 180 percent of the beam of the design vessel (Class 5) or about 125 feet. Once vessels enter the Outer Harbor channels, the yawing forces are reduced and the vessels are traveling at a slower speed whereby the vessel's side thrusters will be effective in improving vessel controllability. The waterway is also much wider than will be needed and the adjacent material in the Outer Harbor is a soft silty material. Therefore, a minimum bank clearance lane equivalent to 60 percent of the beam of the design vessel, or about 65 feet through the southern and middle Outer Harbor channels and about 40 feet through the northern Outer Harbor channel, will be used.

c. Summary of Buffalo Harbor Channel Dimensions.

(1) North Entrance Channel - The north entrance channel into the Port of Buffalo is utilized by Great Lakes vessels which navigate the Buffalo River. Vessels up to the Class 5 (600-649 feet X 68 feet) enter Buffalo Harbor through the north entrance. The results from evaluation of the channel depth requirements for Class 5 bulk cargo vessels, as summarized in Table A8, indicate that the lake approach/entrance channel and north Outer Harbor channel must be deepened to a depth of about 33.0 feet below low water datum. The north entrance channel is about 7,200 feet long and connects the 33-foot depth contour in the lake to the northern Outer Harbor channel. The required minimum width of channel for the north entrance channel is 600 feet and would be of sufficient width to accommodate passing vessels up to the Class 5 bulk cargo vessel.

(2) South Entrance Channel - All 1,000-foot long vessels enter the Port of Buffalo through the south entrance. The results from evaluation of the channel depth requirements for the 1,000-foot long bulk cargo vessels, as well as for the smaller class vessels, as summarized in Table A8, indicate that the lake approach/entrance channel must be deepened to a depth of about 32.0 feet below low water datum. The south entrance channel is about 4,400 feet long and connects the 32-foot depth contour in the lake to the southern Outer Harbor channel. The required minimum width of channel for the south lake approach/entrance channel is 600 feet (rounded up from the required minimum of 530 feet) from deep water in the lake to between the outer ends of the south entrance arm breakwater extension and new 1,000-foot long breakwater. Once in the protected channel area, the south entrance channel widens from 600 feet to 1,250 feet between the ends of the South Breakwater and Stony Point breakwater where the entrance channel connects the southern Outer Harbor channel. The 32-foot channel depth and 600-foot width provides for one-way traffic and will allow all vessels presently operating on the Great Lakes to safely enter the improved south entrance under the design entrance conditions.

(3) Outer Harbor Channels - Presently, the 1,000 foot long vessels which enter the Port of Buffalo use the south entrance channel and southern Outer Harbor channel. However, some alternatives in this Feasibility Study consider vessels up to 1,000 feet in length using transshipment and docking facilities at the Niagara Frontier Transportation Authority docks which are located in the center of the Outer Harbor. Therefore, the southern and middle Outer Harbor channels are designed to accommodate up to 1,000-foot long vessels. The northern Outer Harbor channel is designed to accommodate up to 630-foot long vessels (Class 5) which might use the Outer Harbor channels and north entrance channel to enter or exit the Buffalo River. The results from evaluation of channel depth requirements, as summarized in Table A8, indicate that the southern, middle, and northern Outer Harbor channels must be deepened to a depth of about 30, 28, and 31/33 (see footnotes on Table A8) feet below low water datum, respectfully. The existing 1,400-foot width in the 4,000-foot long southern Outer Harbor channel will be maintained in order to allow turning area for 1,000-foot long vessels which use the Lackawanna and Union Canals. The minimum channel width which is required to accommodate passing vessels up to 1,000 feet in length through the 11,000-foot long middle Outer Harbor channel is 600 feet. The 4,800-foot long northern Outer Harbor channel requires a minimum channel width of 400 feet in order to accommodate passing vessels up to 630 feet in length.

BUFFALO RIVER DEEPENING

A21. GENERAL

The Port of Buffalo includes the lower 5.8 miles of the Buffalo River and also the Buffalo Ship Canal which is about 1-mile in length (see Plate A1). Vessels up to 630 feet in length and with a beam of 68 feet navigate the river destined for upriver docks. The Buffalo River channel and Buffalo Ship Canal are features of the Federally improved harbor and are maintained by the Federal Government to an authorized project depth of 22 feet below low water datum in soft material and 23 feet below low water datum in hard material. The current design static draft for vessels operating in harbors and channels on the Great Lakes is 25.5 feet. Therefore, vessels destined for upriver docks enter Buffalo Harbor either light-loaded in order to navigate the Buffalo River or fully-loaded in which case they unload a sufficient amount of cargo at docks in the Outer Harbor to attain the draft at which they can navigate the Buffalo River. This section will address the design criteria and assumptions used for developing the channel depth that is required to allow vessels that are 630 feet long and 68 feet wide, to navigate the Buffalo River at fully loaded drafts of 25.5 feet. A design system draft of 22.5 feet was also considered for several study alternatives and the required channel depth for the river can be obtained by subtracting 3.0 feet from the required depths presented in Table A10 which are those needed for the 25.5-foot system draft.

A22. DESIGN CHANNEL DEPTH

The new channel depth was selected to safely and efficiently accommodate the passage of the design vessel which is normally the largest vessel (length, beam, and draft) expected to use the channel during the project life. On the Buffalo River, the largest vessel expected to use the navigation channel is the Class 5 (630 feet X 68 feet) bulk cargo vessel. Vessels navigate the river at a speed of about 2 miles per hour due to the many bends and bridges. The channel depth requirement is based on the following significant criteria:

a. The static draft of the vessel at rest;

b. The sinkage or squat of the vessel underway;

c. The amount of vessel roll;

d. The effect of vessel pitch and heave; and

e. Nominal bottom clearance.

The numerical calculations for the required depth were developed from practical and theoretical information in technical reports and papers. The calculations are attached to the end of this appendix and are based on 25.5-foot design system draft and a design minimum water level of 568.8. The following paragraphs discuss the significant criteria which were considered

in determining the required channel depth. The results of the channel depth evaluation are summarized in Table A10.

(1) Vessel Squat - Vessel squat is the lowering of the water surface around a moving vessel which produces a relative change in the ship's position with respect to channel bottom. The procedures which are discussed in paragraph A20a (1), were used in computing the amount of squat that a vessel will experience on the river. Pertinent parameters include: static draft of 25.5 feet; vessel beam width of 68 feet; vessel speed of 2 mph; waterway width of 100 feet (minimum width on river) and channel depth of 28 feet (assumed). The computed squat value is approximately 0.8-foot for the 630-foot long vessel.

(2) Vessel Roll - Vessel roll is rotation of a vessel around its longitudinal axis as a result of waves, wind, and turn angle. Roll is greatest when the vessel hull is parallel to the wave crests. A vessel traveling on Buffalo River will not encounter waves parallel to its hull and, therefore, will not experience any roll due to waves. It is assumed that wind acting on either the port or starboard side of the vessel would cause an insignificant amount of roll. It is also assumed that a vessel, equipped with side thrusters and traveling at a speed of about 2 miles per hour, will not experience any appreciable amount of roll while turning in the bends on the river. Therefore, an allowance for vessel roll will not be included in the channel depth requirement for the Buffalo River.

(3) Vessel Pitch and Heave - Vessel pitch is rotation of a vessel about its transverse axis and heave is the vertical body motion of a vessel. The motions are caused by waves and are greatest when a vessel hull is normal to wave crests. Vessels traveling on the Buffalo River will not encounter waves with a sufficient wavelength that would cause the vessel to experience any pitch or heave. Therefore, an allowance for vessel pitch or heave will not be included in the channel depth requirement for the Buffalo River.

(4) Nominal Bottom Clearance - After all depth requirements are made for vessel squat, roll, pitch and heave, it is desirable to design for additional bottom clearance for vessel safety and efficiency. The common allowances for bottom clearance are 2 feet in soft material and 3 feet in hard material. On the Buffalo River, most of the material is considered to be soft. However, hard material is encountered from around the northern Outer Harbor channel upstream to just above the confluence of the Buffalo Ship canal with the Buffalo River and also in about a 1/2 mile reach in the vicinity of the Ohio Street Bridge (River Mile 2). Therefore, a nominal bottom clearance value of 2 feet will be included in the channel depth requirement where the material is soft and a value of 3 feet will be used where hard material is encountered.

The results from the evaluation of the channel depth requirement for the 630-foot bulk cargo vessels traveling on the Buffalo River, as summarized in Table 10, indicate that the river must be deepened to a depth of 28 feet below low water datum in soft material and 29 feet below low water datum in hard material for vessels loaded to the 25.5-foot design system draft.

Table A9 - Summary of Channel Width Requirements at Buffalo Harbor

Channel	Maneuvering Lane(s) (Feet)	Ship Clearance Lane (Feet)	Bank Clearance Lanes (Feet)	Minimum Required Width (Feet)
South Entrance	210	-	320	530
North Entrance	280	70	250	600
Southern Outer Harbor	380	95	130	605
Middle Outer Harbor	380	95	130	605
Northern Outer Harbor	250	60	80	390

Table A10 - Summary of Channel Depth Required on the Buffalo River

Depth Requirement	Value in Soft Material	Value in Hard Material
a. Design Minimum Water Level	EL. 568.8	EL. 568.8
b. Vessel Draft	- 25.5 Feet	- 25.5 Feet
c. Vessel Squat	- 0.8 Feet	- 0.8 Feet
d. Vessel Roll	- 0.0	- 0.0
e. Vessel Pitch and Heave	- 0.0	- 0.0
f. Nominal Bottom Clearance	- 2.0 Feet	- 3.0 Feet
Channel Bottom Elevation	EL. 540.5 Feet	EL 539.5
Channel Bottom Below LWD (1)	Use 28.0 Feet	Use 29.0 Feet

(1) Low Water Datum = 568.6 feet above Father Point, Quebec, Canada.

NFTA SMALL-BOAT HARBOR

A23. GENERAL

This section will address the wave problems which are affecting small-boat moorings and usage in the Niagara Frontier Transportation Authority (NFTA) small-boat harbor which is located in the Outer Harbor of the Port of Buffalo. Also addressed in this section are improvements which could be incorporated to upgrade the existing slag stone dike which encircles the NFTA Small-Boat Harbor and is in a state of disrepair as well as the improvements which could be made to alleviate the adverse wave activity which is affecting moorings and usage of the small-boat harbor.

The NFTA Small-Boat Harbor is located along the east shore of the Buffalo Outer Harbor area approximately 2,200 feet in the lee of the South Breakwater which separates the Outer Harbor from Lake Erie. The NFTA Small-Boat Harbor was constructed in the early 1950's and consists of mooring stalls for pleasure craft and a dike structure to protect the mooring area from waves which overtop the South Breakwater. The dike structure was built using slag material and when initially constructed consisted of a 1,000-foot long lakeward (westerly) extension from its shore connection to a point where it turned sharply to a northerly direction and extended about 2,000 feet where it then doglegged and extended lakeward in a westerly direction for about 400 feet. The entrance channel to the small-boat harbor, located between the outer end of the dogleg extension and Freezer Queen Foods, Inc. dock, was approximately 300 feet wide. The plan showing the layout of the NFTA small-boat harbor as originally constructed is shown on Plate A6.

In the latter 1960's, modifications to the northerly end of the NFTA small-boat harbor dike were made in order to construct a water intake structure and a 10-foot waterline. The modifications to the dike entailed removal of the existing 400-foot long dogleg extension, removal of about 500 feet of dike from the existing northermost end of the 2,000-foot long south-north extension, thereby shortening the dike to about 1,500 feet, and construction of a new 400-foot long dogleg extension in a landward (easterly) direction. The entrance channel to the small-boat harbor located between the end of the dogleg extension and the Freezer Queen Foods, Inc. dock was increased to about 800 feet in width. The plan showing the existing layout of the NFTA small-boat harbor is shown on Plate A7.

The slag dike was not structurally suitable to withstand waves which occur in the Outer Harbor area as a result of overtopping of the South Breakwater. In order to maintain a protected mooring area, the NFTA has had to periodically restore the crest elevation and slope of the dike by adding additional slag. During the late 1970's, in an attempt to protect the lakeward face of the dike, large reinforced concrete pavement slabs from a bridge restoration project were dumped on the lakeward face of the dike. These concrete pavement slabs, in addition to creating an unsightly structure, have accelerated the degradation of the slag dike by increasing wave runup on the face of the dike due to the smooth surface provided by the slabs. The combination of waves which enter directly into the widened entrance of the small-boat harbor and

those which diffract into the dockage and mooring area have created undesirable wave conditions in the entrance, dockage and mooring areas causing damage to docks and boats. Therefore, alternative plans which would reduce wave activity in the entrance area and boat basin were investigated and plans which would provide temporary improvement to the dike and future development in the lakefront area were developed.

A24. DESIGN TRANSMITTED WAVES

The Niagara Frontier Transportation Authority small-boat harbor is located in the lee of the Buffalo Harbor South Breakwater. During storm conditions, the South Breakwter is subjected to severe wave overtopping and waves which are transmitted into the Outer Harbor create undesirable wave conditions in the small-boat harbor. An analysis was undertaken to first determine the incident waves at the South Breakwater and then compute the wave transmission in the lee of the South Breakwater which results from energy being passed through the breakwater and due to overtopping when wave runup exceeds the crest elevation of the South Breakwater. The analysis considered two water level conditions, the design maximum water level (see paragraph A6) and a boating season water level. A 10-year recurrence water level during the boating season was determined by combination of a 10-year fourth quarter (fall) mean lake level (EL 571.6 from Figure A5) with a 12-month short period fluctuation (4.9 feet from Figure A4) to obtain a 10-year boating season water level of 576.5 or +7.9 feet (LWD).

The significant deep water waves from angle class 2 which occur during the fall and winter seasons and have a 20-year recurrence interval (see Table A2) were superimposed on the corresponding water level. Refraction and shoaling analyses were accomplished according to the procedures discussed in paragraphs A11 and A12 to obtain the incident waves at the South Breakwater. Tables A11 through A14 provide a summary of the steps followed to determine the refraction coefficients and deduce the incident waves at the South Breakwater for the two design conditions analyzed. The results indicate that maximum (H_{max}) 24.8-foot and significant (H_{sig}) 15.0-foot incident waves can occur at the South Breakwater during the winter and fall seasons, respectively.

An estimation of the wave heights transmitted in the lee of the South Breakwater, which has a crest elevation of 14.5 feet above low water datum, was analyzed using the method provided in CETA 79-6 entitled "Estimation of Wave Transmission Coefficients for Permeable Breakwaters," and TR-80- entitled "Two Dimensional Tests of Wave Transmision and Reflection Characteristics of Laboratory Breakwaters." The computer program MADSEN was used to predict the transmitted wave heights in the lee of the breakwater resulting from wave transmission through the structure and wave transmission by overtopping due to irregular waves. The results from the MADSEN computer program indicate that about a 6.0-foot transmitted wave can be generated in Buffalo Outer Harbor during the winter season and a 4.0-foot transmitted wave can occur during the boating season.

Table A11 - Determination of Refraction Coefficient (K_r) for Design Winter Season Wave

Wave Angle Class	(Degrees)	Design Water Level	Depth Contour	d (Feet)	g (Feet/Sec^2)	T_s (Seconds)	d/gT_s^2	K_r
2	0	+9.0 (LWD)	27.5	36.5	32.2	9.8	0.012	0.925

Table A12 - Determination of Refraction Coefficient (K_r) for Design Boating Season Wave

Wave Angle Class	(Degrees)	Design Water Level	Depth Contour	d (Feet)	g (Feet/Sec^2)	T_s (Seconds)	d/gT_s^2	K_r
2	0	+7.9 (LWD)	27.5	35.4	32.2	9.3	0.013	0.93

Table A13 - Determination of Design Incident (H_{max}) Winter Season Wave at South Breakwater

Wave Angle Class	H_o	K_r	$H'_o=H_oK_r$	d_s	T_s	$L_o=5.12\ T_s^2$	H'_o/L_o	d_s/H'_o	Slope	H_{max}/H'_o	H_{max}
	(Feet)		(Feet)	(Feet)	(Seconds)	(Feet)			(Feet)		
2	17.7	0.925	16.4	36.5	9.8	491.7	0.033	2.23	0.001	1.51	24.8

Table A14 - Determination of Design Incident (H_{sig}) Boating Season Wave at South Breakwater

Wave Angle Class	H_o	K_r	$H'_o=H_oK_r$	d_s	T_s	$L_o=5.12\ T_s^2$	H'_o/L_o	d_s/H'_o	Slope	H_{sig}/H'_o	H_{sig}
	(Feet)		(Feet)	(Feet)	(Seconds)	(Feet)			(Feet)		
2	16.4	0.93	15.3	35.4	9.3	442.8	0.035	2.31	0.001	0.98	15.0

A25. WAVE CONDITIONS AT NFTA SMALL-BOAT HARBOR

The waves which are generated in the Outer Harbor as a result of wave transmission through and over the South Breakwater will propagate into the area of the small boat harbor. Discussions with personnel at the NFTA indicated that, prior to modification of the dike structure for construction of the water intake structure and the 10-foot waterline, there were no undesirable wave activity occurring in the entrance, dockage and mooring areas of the small-boat harbor.

A wave diffraction analysis was undertaken in order to compare boating season wave conditions that existed prior to the dike modification with those for the existing harbor. The analysis utilized diffraction diagrams in the Shore Protection Manual assuming end diffraction around the dogleg portion of the NFTA dike. A diffraction diagram was constructed for the direct incoming boating season wave (approximately 4.0 feet) for the dike alignment which existed prior to modification (Figure A11) and for the existing harbor configuration (Figure A12). Figure 2-29 in the Shore Protection Manual was utilized to construct the diffraction diagram shown in Figure A11 and Figure 2-38 in the Shore Protection Manual was utilized to construct the diffraction diagram shown in Figure A12. Comparison of the diffraction isolines plotted for the two dike alignments indicate that the dike as initially constructed (Figure A11) provided provided calmer conditions in the entrance and dockage area than the existing dike alignment (Figure A12). The diffraction analysis disregards the Freezer Queen Foods, Inc. dock which is vertical faced and probably further complicates the wave conditions in the entrance, dockage, and mooring areas due to wave reflection off the dock face.

Wave overtopping of the existing NFTA dike is considered to have an insignificant effect on wave transmission into the mooring area. Survey information obtained in June 1982 indicates that the crest elevation of the dike varies from approximately 7.5 feet above low water datum to about 14.0 feet above low water datum. The crest width of the slag portion of the dike is over 20 feet wide and with the concrete slab protection on the lakeward face, the crest width increases to nearly 30 feet (see Existing Slag Dike Section on Plate A8). Based on these structure parameters, the amount of wave overtopping due to a 4.0 to 6.0-foot incident wave superimposed on the design water level would be insignificant and generate a wave less than 1.0 foot in height in the mooring area.

A26. IMPROVEMENTS TO THE EXISTING NFTA SMALL-BOAT HARBOR

Widening of the gap between the end of the NFTA dike structure and the Freezer Queen, Inc. dock for construction of the water intake structure and waterline allows the waves which overtop the South Breakwater to propagate directly into the entrance area to the small-boat harbor and diffract around the end of the dike into the dockage and mooring areas. These waves, when superimposed on the design water levels, have caused damage to docks and have sank boats moored in the small-boat harbor. Wave activity was not a problem before construction of the water intake structure and the waterline. Therefore, realignment of the dike to its original configuration should be considered to eliminate the undesirable wave conditions which now occur.

BY KJG DATE 7/.. SUBJECT Buffalo Harbor NY
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SHEET NO. .... OF ....
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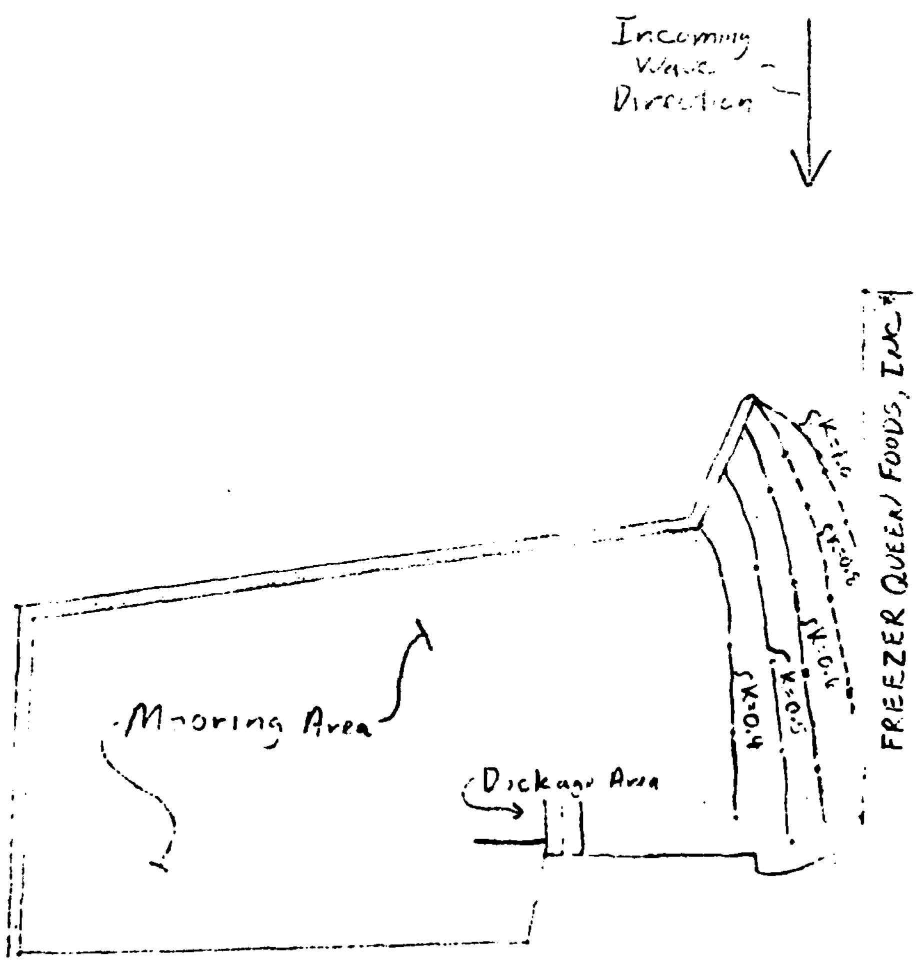
End Diffraction

$d = 19.0$ feet
$H = 4.0$ feet
$T_c = 9.3$ sec
$L_o = 5.12\,T^2 = 442.8$ feet
$L = 224$ feet
Angle of Approach with Respect to Breakwater = 24°

Use: SPM Figure 2-29



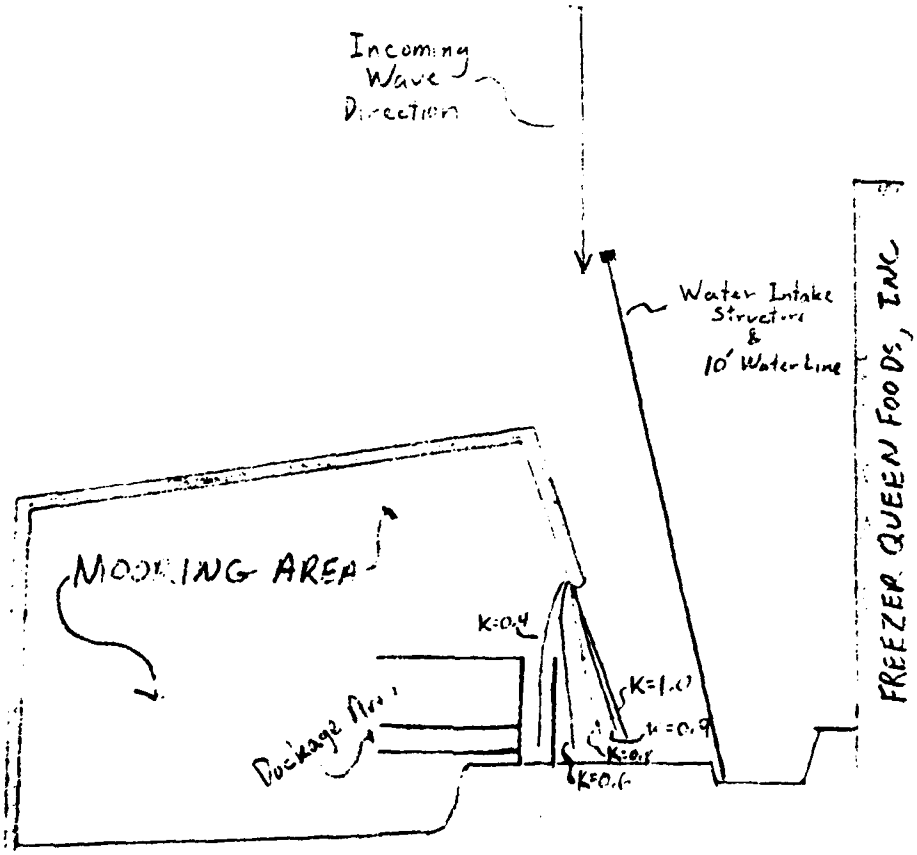
Scale 1" = 500'

Figure A11 - Diffraction Diagram for NFTA Dike Alignment Prior to Modification

BY K J G DATE 1/82 SUBJECT Buffalo Harbor NY SHEET NO. ...... OF ......
CHKD. BY ...... DATE ...... NFTA Small Boat Harbor JOB NO. ......

End Diffraction

$d = 13.9$ feet
T_0 : 9.3 sec
$L_0 = 5.12\, T^2 = 442.8$ feet
$H = 4.0$ feet
$L = 191$ feet
Angle of Approach with Respect to Breakwater = 165°
Use SPM Figure 2-38



Scale: 1" = 500'

Figure A12 - Diffraction Diagram for Existing NFTA Dike Alignment

Realignment of the dike to its original configuration will entail placement of material over the 10-foot waterline. An analysis of the waterline will be required in order to determine whether the line needs to be modified to support the dike.

Survey information obtained in April 1967 indicated that the crest elevation of the dike ranged from about 12.5 feet above low water datum to 14.5 feet above low water datum and had sideslopes flatter than 1.0 vertical on 3.0 horizontal. Therefore,in realigning the dike to its original configuration (.i.e., extending the 1,500-foot long north-south dike 500 feet northward and construction of the 400-foot long lakeward dogleg extension), it is recommended that a crest elevation of 14.0 feet above low water datum and sideslopes of 1.0 vertical on 3.0 horizontal be used. The 20-foot crest width which exists on the present dike will be maintained on the realigned dike. Typical sections which are recommended for the dike realignment are shown on Plates A9 and A10. A 2.0-foot thick layer of 50-pound to 200-pound underlayer stone and a 4.0-foot thick layer of 800-pound to 1,750-pound armor stone is required to protect the lakeward face of the dike and is also required on the harbor side of the dogleg dike section. In order to upgrade the exisiting 1,500-foot long section of slag dike, it is recommended that the reinforced concrete pavement slabs be removed, the existing crest elevation be raised with new slag to 14.0 feet above low water datum, the dike sideslopes be regraded with new slag to 1.0 vertical on 3.0 horizontal, and a 2.0-foot thick layer of 50-pound to 200-pound underlayer stone and a 4.0-foot thick layer of 800-pound to 1,750-pound armor stone be placed on the lakeward face to protect the dike. The existing 20-foot wide crest width will be maintained on the entire length of dike. A typical section showing the improvements required to upgrade the existing 1,500-foot length of dike is shown on Plate A8. A crest elevation of 14.0 feet above low water datum for the dike would not allow wave overtopping of the structure for the maximum (H_{max}) wave condition. Therefore, armor protection of the crest and backside of the dike is not required, except on the dogleg section where incoming waves diffract around the end of the dike (see Figure A11). The computations for stone design and crest elevation are attached in the calculations section at the end of the appendix.

OFFSHORE ISLANDS

A27. INTRODUCTION

A potential source of land for recreational activities in the Buffalo area is the building of offshore islands. This alternative would provide opportunities for expanded fishing, hiking, picnicking, wildlife habitat, and an improved recreational boating environment.

A28. DESIGN CRITERIA

The stability of an offshore island depends on its ability to resist erosive forces caused by the surrounding wave climate. Therefore, the perimeter of the island has to be fully protected against erosion and be impermeable to prevent movement of the fill material through the surrounding structure. The elevation of the island must be such that wave overtopping is not permitted or provisions must be made to accommodate any wave overtopping which may occur.

Existing Corps diked disposal areas constructed adjacent to the Bethlehem Steel Corporation at the south entrance to Buffalo Harbor and at the NFTA small-boat harbor conform to the design criteria established for an offshore island except that the existing diked areas allow wave overtopping during storm conditions. In this Preliminary Feasibility stage, the design of the offshore islands at Buffalo will follow the same pattern as that used for the existing diked areas.

A method, similar to that which can be used for Buffalo Harbor, has been employed by the Metropolitan Toronto and Region Conservation Authority for the creation of recreational lands. A new waterfront parkland was created in the Toronto waterfront through controlled lake filling at points where regional access could be extended to the lakeshore. The new lands were created by using locally generated construction, excavation, and selected demolition materials placed to minimize the probability of erosion losses through wave action. The clean fill and rubble are segregated into three categories: core, beach material, and hardpoint armor. The hard point armor consists of large pieces of concrete and concrete with reinforcing. Small to medium sized broken concrete, brick rubble, broken asphalt and road base gravel, and crushed stone are used as beach material. Core material consists of dry clean earth, clay, silt, fine sands and shale. The program at the Toronto waterfront was made possible by the availability of large volumes of earth fill and construction rubble. Design pre-requisites are the wave climate and a knowledge of the behavior of different sizes, shapes, and types of material when subjected to wave action. The success of this type of project in Toronto may serve as a pattern for design of offshore islands in Buffalo Harbor.

At this stage of study, the design of offshore islands in Buffalo Harbor will be limited to a structure similar to existing diked areas. This design will provide adequate protection against the wave climate and allow the use of fill materials, such as dredged materials, which the Environmental Protection Agency requires be confined. Refinements to this design could be made at later stages to reflect the practices used in the metropolitan Toronto Region.

To allow flexibility in future site selection, two typical cross sections of shoreline protection have been developed. Typical cross sections of shoreline protection for the islands will be presented for a dike at the 10-foot depth contour and for a dike at the 30-foot depth contour.

The protection designed for an island built at the 10-foot depth contour will be similar to the dike design developed for the NFTA small-boat harbor in the preceeding section of this appendix. For cost estimating purposes, the cross section shown on Plate A11 will be used to protect the island's shoreline. This cross section can be modified following site selection to accommodate the wave climate of the site. An adjustment to this cross section will be necessary with respect to crest height and armor protection. The cross section shown can be used in a protected harbor area and does not allow wave overtopping during storm conditions. An increase in the crest height, armor protection requirements, or implementation of facilities capable of handling water conditions on the island, which are caused by wave overtopping, will be necessary if implemented in an area which is subjected to greater than a 6-foot wave.

The second condition analyzed consisted of construction of an island at the 30-foot depth contour. In October 1973, a study was conducted for the Buffalo District entitled "Design Analysis - Disposal Area Development for Harbor Dredgings, Buffalo Harbor, NY," by DeLeow, Cather and Company, and provides the design for the Corps of Engineers Disposal Area Site 4. This disposal area was designed for construction at the 30-foot depth contour. The rubblemound typical cross section developed in the 1973 report will be the basis for determining the approximate cost of an island built in 30 feet of water with similar foundation conditions to warrant the need for the 50-foot berms. A typical cross section of the structure which would be used to protect the perimeter of the island is shown on Plate A12. This design allows wave overtopping during storm conditions. Therefore, as stated previously, an increase in the crest height or implementation of water control structures will be necessary if this cross section is to be used as island protection. Modification of this design may be necessary following site selection to accommodate for the wave conditions at the site.

Fill material for construction of either option will be determined on the basis of availability and will be subject to approval by the Environmental Protection Agency.

A29. SUMMARY

The elements which will determine if, when, and where offshore islands can be implemented, include availability of fill material, the Environmental Protection Agency requirements for containment and use of various materials, costs, environmental impacts, and future demand for additional recreational facilities.

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BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

STONE DESIGN AND CHANNEL DESIGN COMPUTATIONS

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Armor Stone	1
Thickness of Armor Stone Layer	1
Crest Width	1
Underlayer Stone	2
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WAVE OVERTOPPING & TRANSMITTED WAVES	3
Conditions for 8-Foot Incident Waves	3
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CHANNEL DEPTH DESIGN	1A
A) SOUTH ENTRANCE PLAN	1A
1) Class 10 Vessels	1A
a) Squat	1A
b) Nominal Bottom Clearance	2A
c) Roll	2A
d) Pitch and Heave	2A
e) Required Depth	3A
2) Class 8 Vessels	4A
a) Squat	4A
b) Nominal Bottom Clearance	4A
c) Roll	4A
d) Pitch and Heave	4A
e) Required Depth	5A
3) Class 7 Vessels	5A
a) Squat	5A
b) Nominal Bottom Clearance	5A

BY .... DATE ....

CHKD. BY .... DATE ....

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c) Roll	6A
d) Pitch and Heave	6A
e) Required Depth	6A
4) Class 6 Vessels	6A
a) Squat	6A
b) Nominal Bottom Clearance	7A
c) Roll	7A
d) Pitch and Heave	7A
e) Required Depth	7A
5) Class 5 Vessels	8A
a) Squat	8A
b) Nominal Bottom Clearance	8A
c) Roll	8A
d) Pitch and Heave	8A
e) Required Depth	8A
B) NORTH ENTRANCE PLAN	1B
1) Class 5 Vessels	1B
C) OUTER HARBOR CHANNELS	1C
1) SOUTH OUTER HARBOR CHANNEL	1C
a) Squat	1C
b) Nominal Bottom Clearance	1C
c) Roll	1C
d) Pitch and Heave	2C
e) Required Depth	2C
2) MIDDLE OUTER HARBOR CHANNEL	2C
3) NORTH OUTER HARBOR CHANNEL	3C
a) Squat	3C
b) Nominal Bottom Clearance	3C
c) Roll	3C
d) Pitch and Heave	4C
e) Required Depth	4C
D) BUFFALO RIVER DEEPENING	1D
1) Class 5 Vessel	1D

BY ....DATE	SUBJECT Buffalo Harbor, NY	SHEET NO. iii OF iii
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a) Squat	1D
b) Nominal Bottom Clearance	1D
c) Vessel Roll	1D
d) Pitch and Heave	2D
e) Required Depth	2D
NFTA SMALL BOAT HARBOR	1F
STONE DESIGN	1F
Armor Stone	1F
Thickness of Armor Layer	1F
Underlayer Stone	1F
Thickness of Underlayer	1F
Crest Elevation / Wave Runup	2F

Hudson's Formula:

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

$w_r = 160$ lb/ft^3

$H = 16.0$ feet (nonbreaking)

$k_D = 4.0$

$S_r = 160 \div 62.4 = 2.56$

$\cot\theta = 1.5$

$$W = \frac{(160)(16)^3}{(4)(2.56-1)^3(1.5)} = 28{,}769 \text{ lbs} = 14.4 \text{ Tons}$$

Armor Stone:

$W_{max} = 2.0\ W = (2.0)(14.4) = 28.8$ Tons

$W_{min} = 0.9\ W = (0.9)(14.4) = 13.0$ Tons

Use 13 Ton to 29 Ton Armor Stone

Thickness of Armor Stone Layer:

$$r = n\, k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

$n = 2$ stones

$k_\Delta = 1.15$

$W = 28{,}769$ lbs

$w_r = 160$ lb/ft^3

$$r = (2)(1.15)\left(\frac{28{,}769}{160}\right)^{1/3} = 13.0 \text{ feet}$$

Crest Width:

$$B = n\, k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

$n = 3$ stones

$k_\Delta = 1.15$

$W = 28{,}769$ lbs

$w_r = 160$ lbs/ft^3

$$B = (3)(1.15)\left(\frac{28{,}769}{160}\right)^{1/3} = 19.5 \text{ feet}$$

Underlayer Stone:

$$W_{max} = 0.2W = (0.2)(14.4) = 2.9 \text{ Tons}$$

$$W_{min} = 0.06W = (0.06)(14.4) = 0.9 \text{ Tons}$$

Use 1 Ton to 3 Tons Underlayer Stone

Thickness of Underlayer Stone:

$$r = n k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

$n = 2$ stones

$k_\Delta = 1.15$

$W = 28{,}769 \div 10 = 2877$ lbs

$w_r = 160$ lbs/ft^3

$$r = (2)(1.15)\left(\frac{2877}{160}\right)^{1/3} = 6.0 \text{ feet}$$

Bedding Layer and Core Stone:

$$W_{max} = 0.01W = (0.01)(28{,}769) = 288 \text{ lbs}$$

$$W_{min} = 0.00015W = (0.00015)(28{,}769) = 4 \text{ lbs}$$

Use 4 lbs to 300 lbs Bedding Stone and Core Stone

A workshop with vessel masters of 1,000-ft vessels which are operating on The Great Lakes was held in Cleveland, Ohio on 8 April 1981 to obtain information on entrance conditions for the Cleveland Harbor Study. At the workshop, the vessel masters stated that they would not attempt to enter Cleveland Harbor when wave conditions at the entrance exceed 8.0 feet. The vessel masters also stated that the wave in the entrance channel should be in the 2 to 3-foot range in order for the masters to be able to maintain control of their vessels with vessel side thrusters under reduced vessel speeds. It is assumed that the 8.0-foot wave condition at the entrance and 2 to 3-foot wave in the entrance channel are applicable to the Buffalo Harbor study also. Therefore, the following analysis was used to determine the condition which would create an 8-foot wave at the entrance and to determine the height of the transmitted wave in the entrance channel due to overtopping of structural modifications.

Determination of Conditions for 8.0 ft Incident Waves

8-foot incident waves at the entrance channel from angle class 1 or 3 would be an infrequent event (100-year recurrence event or greater) and therefore, were not considered in this analysis (see Table B2 for recurrence interval).

Therefore, from Table C3, Assume an Angle Class 2

$H_o = 9.0$ feet with a wave period where

$T_o = 7.0$ seconds

$d_s = 39.0$ feet

$g = 32.2$ ft/sec^2

$$\frac{d}{gT^2} = \frac{39}{(32.2)(7)^2} = 0.025$$

from Figure C5, for $\alpha_o = 0°$ and $\frac{d}{gT^2} = 0.025$

$K_R = 0.94$

$H_o' = K_R H_o = (0.94)(9) = 8.4$ feet

$L_o = 5.12\,T^2 = 5.12(7)^2 = 250.9$ feet

$$\frac{H_o'}{L_o} = \frac{8.4}{250.9} = 0.033$$

$$\frac{d_s}{H_o'} = \frac{39}{8.4} = 4.6$$

$$\frac{H_{sig}}{H_o'} = 0.95$$

$$H_{sig} = 0.95(H_o') = 0.95(8.4) = 8.0 \text{ feet}$$

Determination of Transmitted Wave Height

The 2 to 3 foot wave in the entrance channel for vessel maneuverability is of concern during the navigation season. From Table C2, the 9-ft deep water wave which causes an 8.0-ft wave at the entrance and which is being analyzed to satisfy the 2-3-ft wave in the entrance channel, can occur during the navigation season (spring thru fall) from angle class 2 with less than 5 year recurrence interval.

a. Wave Runup:

$$R = \left(\frac{a\,\varepsilon}{1 + b\,\varepsilon}\right) H_i$$

where a = runup coefficient = 0.692
b = runup coefficient = 0.504
H_i = 8.0 feet
ε = surf parameter

$$\varepsilon = \frac{\tan\theta}{\sqrt{H_i / L_o}}$$

$$\tan\theta = \frac{1}{1.5} = 0.667$$

$$L_o = 5.12\,T^2 = 5.12(7)^2 = 250.9 \text{ feet}$$

$$\varepsilon = \frac{0.667}{\sqrt{8.0/250.9}} = 3.74$$

$$R = \frac{(0.692)(3.74)}{1 + (0.504)(3.74)}(8.0) = 7.2 \text{ feet}$$

b. Wave Transmission by Overtopping:

$$K_{TO} = C(1 - F/R)$$

where R = wave runup = 7.2 feet
F = breakwater freeboard = structure height (h) − d_s

The majority of the existing breakwaters at Buffalo Harbor are at elevation 583.1 (+14.5 feet above low water datum), therefore, any new structural

modifications will be consistent with the elevation of the existing breakwaters. Therefore

$$h = 583.1 - 538.6 = 44.5 \text{ feet}$$

$$d_s = 39.0 \text{ feet}$$

$$F = h - d_s = 44.5 - 39.0 = 5.5 \text{ feet}$$

$$C = 0.51 - 0.11\ B/h$$

$$B = 19.5 \text{ feet}$$

$$C = 0.51 - 0.11\ (19.5/44.5) = 0.46$$

$$K_{TO} = 0.46\,(1 - 5.5/7.2) = 0.11$$

Assuming that wave transmission through the structure is negligible, then

$$K_T = K_{TO} = \frac{H_T}{H_I}$$

$$H_T = (K_{TO})(H_I) = (0.11)(8.0) = 0.9 \text{ feet}$$

say 1.0 ft.

Based on the results from this analysis, the crest height of the structural modifications can be less than the +14.5 feet on the existing structures and satisfy the 2-3 foot wave height criterion in the entrance channel during the navigation season. However, in order not to increase the wave activity inside the Outer Harbor, over those which occur for existing conditions, during episodes of more severe wave activity in the lake, the 14.5-foot above low water datum crest elevation will be maintained on all structural modifications.

A) South Entrance Plan

1) Class 10 Vessels (950'-1000' x 105')

a) Squat - Graphical Method

A - Vessel cross sectional area
$= 105' \times 25.5' = 2677.5\ ft^2$

W - Channel width = 600'

H - Channel water depth
= 32' (assumed depth based on minimum design water level)

S - Blockage ratio of ship to channel cross section

$$S = \frac{A}{WH} = \frac{2677.5\ ft^2}{600'(32')} = 0.14$$

V - Ship design speed = 6 mph
= 8.8 ft/sec (per vessel masters at 8 April 81 workshop held in Cleveland OH)

g - Acceleration of gravity
$= 32.2\ ft/sec^2$

F - Froude number

$$F = \frac{V}{(gH)^{1/2}} = \frac{8.8\ ft/sec}{((32.2\ ft/sec^2)(32'))^{1/2}} = 0.27$$

D - Dimensionless squat

Z - Squat in feet

$$D = \frac{Z}{H} = 0.015 \quad \text{(from Figure A 10)}$$

$$Z = 0.015(32) = \underline{\underline{0.5\ \text{feet}}}$$

SQUAT(S) – EMPIRICAL METHOD

V_1 – SHIP VELOCITY (fps) RELATIVE TO WATER
= 8.8 fps

A_1 – CROSS SECTIONAL AREA OF CHANNEL
$= 600' \times 32' = 19{,}200\ ft^2$

A_2 – CROSS SECTIONAL AREA OF VESSEL
$= 105' \times 25.5' = 2677.5\ ft^2$

$A_w = A_1 - A_2 = 19{,}200 - 2677.5 = 16{,}522.5\ ft^2$

$g = 32.2\ ft/sec$

$$S = \frac{V_1^2}{2g}\left[\left(1.01\,\frac{A_1}{A_w}\right)^2 - 0.84\right]$$

$$S = \frac{(8.8)^2}{(2)32.2}\left[1.01\,\frac{19{,}200}{16{,}522.5}^{2} - 0.84\right]$$

$S = 0.7$ feet

b) NOMINAL BOTTOM CLEARANCE:
USE 2.0 FEET – ACCEPTED CRITERIA FOR SOFT CHANNEL BOTTOMS

c) ROLL – AT A 8 APRIL 1981 WORKSHOP HELD IN CLEVELAND, THE VESSEL MASTERS OF 1000' VESSELS INDICATED THAT THE MAXIMUM ROLL WOULD BE IN THE RANGE OF 3-5 DEGREES. THIS ANALYSIS WILL USE 4°.

Y – DEPTH REQUIREMENT DUE TO ROLL
B – VESSEL BEAM = 105'
θ – MAXIMUM ROLL IN DEGREES = 4°

$$Y = \frac{B}{2}\sin\theta = \frac{105'}{2}\sin 4^\circ = 3.7'$$

d) PITCH & HEAVE – AT THE 8 APRIL 1981 WORKSHOP HELD WITH THE VESSEL MASTERS OF 1000' VESSELS WHICH ARE PRESENTLY OPERATING ON THE GREAT LAKES, IT WAS STATED THAT THE MASTERS WOULD NOT ATTEMPT TO ENTER A HARBOR WHEN WAVE CONDITIONS AT THE ENTRANCE EXCEED 8'. THEREFORE THE PITCH & HEAVE WILL BE DETERMINED BASED ON A 8' WAVE HEIGHT

d) PITCH & HEAVE (con't)

$$PITCH = \frac{\theta L}{2} = 0.1H \qquad \frac{HEAVE}{H} = 0.1 \quad \text{WHERE: } H \text{- wave amplitude} = 8'$$

$$\frac{\theta L}{2} + HEAVE = 2(0.1)(H) = 2(0.1)(8.0)$$

$$\frac{\theta L}{2} + HEAVE = \underline{1.6'}\ *$$

* THE ROLL REQUIREMENT GOVERNS OVER THIS PITCH & HEAVE VALUE.

e) REQUIRED DEPTH IN LAKE APPROACH AND ENTRANCE CHANNEL AT SOUTH ENTRANCE FOR THE CLASS 10 VESSELS (950'-1000'x105'):

CASE 1 - UTILIZES SQUAT VALUE FROM GRAPHICAL METHOD
CASE 2 - UTILIZES SQUAT VALUE FROM EMPIRICAL FORMULA

	CASE 1	CASE 2
STATIC DRAFT	25.5	25.5
SQUAT	0.5	.7
ROLL	3.7	3.7
PITCH & HEAVE	—	—
NOMINAL CLEARANCE	2.0	2.0
REQUIRED DEPTH	31.7'	31.9'

USE A CHANNEL DEPTH REQUIREMENT OF 32 FEET BELOW LWD IN THE LAKE APPROACH CHANNEL AND ENTIRE ENTRANCE CHANNEL

2) CLASS 8 VESSELS (731'-849' X 70')

a) SQUAT - GRAPHICAL METHOD

$A = 70' \times 25.5 = 1{,}785\ ft^2$

$W = 600'$

$H = 32'$ (assumed)

$$S = \frac{A}{WH} = \frac{1785}{600(32)} = .09$$

$V = 8.8\ ft/sec$

$g = 32.2\ ft/sec^2$

$$F = \frac{V}{(gH)^{1/2}} = \frac{8.8}{[(32.2)(32)]^{1/2}} = 0.27$$

$$D = \frac{Z}{H} = .009 \quad \text{(from Figure A10)}$$

$$Z = .009(32) = \underline{\underline{0.3'}}$$

SQUAT - EMPIRICAL METHOD

$V_1 = 8.8\ ft/sec$

$A_1 = 600' \times 32' = 19{,}200\ ft^2$

$A_2 = 1785\ ft^2$

$A_W = 19{,}200 - 1785 = 17{,}415\ ft^2$

$g = 32.2\ ft/sec^2$

$$S = \frac{V_1^2}{2g}\left[\left(1.01\frac{A_1}{A_W}\right)^2 - .84\right]$$

$$S = \frac{(8.8)^2}{2(32.2)}\left[\left(1.01\frac{19200}{17415}\right)^2 - .84\right] = \underline{\underline{0.5'}}$$

b) NOMINAL BOTTOM CLEARANCE — USE 2'

c) ROLL - ACCORDING TO THE STUDY REPORT OF VESSEL CLEARANCE CRITERIA FOR THE GREAT LAKES CONNECTING CHANNELS PREPARED BY MICHAEL BAKER, INC FOR DETROIT DISTRICT, THE ROLL ON SMALLER VESSELS IS GREATER THAN FOR 1000' VESSELS, WITH A VALUE OF ABOUT 5 DEGREES. AT THE 8 APRIL 1981 WORKSHOP HELD IN CLEVELAND, THE VESSEL MASTERS OF THE 1000' VESSELS INDICATED THAT THE ROLL ON SMALLER VESSELS IS ABOUT 1½ TIMES THAT OF THE 1000' VESSELS OR APPROXIMATELY 5 TO 7 DEGREES. THIS ANALYSIS WILL USE 6°.

$$Y = \tfrac{1}{2}(B)\sin\theta = \tfrac{1}{2}(70)(\sin 6°) = \underline{3.7'}$$

d) PITCH & HEAVE

$$PITCH = \frac{\theta L}{2} = .1H$$

$$\frac{\theta L}{2} + HEAVE = 2(0.1)(H) = 2(0.1)(8)$$

$$\frac{\theta L}{2} + HEAVE = \underline{\underline{1.6'}}$$

THE ROLL REQUIREMENT GOVERNS OVER THIS PITCH & HEAVE VALUE.

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e) REQUIRED DEPTH IN THE LAKE APPROACH & ENTRANCE CHANNELS AT THE SOUTH ENTRANCE FOR THE CLASS 8 VESSELS (731'-849 X 70'):

CASE 1 UTILIZES SQUAT VALUE FROM GRAPHICAL METHOD

CASE 2 UTILIZES SQUAT VALUE FROM EMPIRICAL METHOD.

	CASE 1	CASE 2
STATIC DRAFT	25.5	25.5
SQUAT	.3	.5
ROLL	3.7	3.7
PITCH & HEAVE	—	—
NOMINAL CLEARANCE	2.0	2.0
REQUIRED DEPTH	31.5	31.7

USE A CHANNEL DEPTH REQUIREMENT OF 32' BELOW LWD IN THE LAKE APPROACH CHANNEL & ENTIRE ENTRANCE CHANNEL,

3) CLASS 7 VESSELS (700' x 730' x 75')

a) SQUAT - GRAPHICAL METHOD

$A_2 = 75' \times 25.5' = 1912.5\ FT^2$

$W = 600'$

$H = 32'$ (assumed)

$S = \frac{A}{WH} = \frac{1912.5}{(600)(32)} = .10$

$V = 6mph = 8.8\ ft/sec$

$g = 32.2\ ft/sec^2$

$F = \frac{V}{\sqrt{gH}} = \frac{8.8}{\sqrt{32(32.2)}} = 0.27$

$D = \frac{Z}{H} = .012$ (from Figure A10)

$Z = .012(32) = \underline{0.4'}$

SQUAT - EMPIRICAL METHOD

$V_1 = 8.8\ fps$

$A_1 = 19,200\ ft^2$

$A_2 = 1912.5 ft^2$

$A_w = 19,200 - 1912.5 = 17,287.5\ ft^2$

$g = 32.2\ ft/sec^2$

$S = \frac{V^2}{2g}\left[1.01\left(\frac{A}{A_w}\right)^2 - .84\right]$

$S = \frac{(8.8)^2}{2(32.2)}\left[(1.01)\left(\frac{19,200}{17,287.5}\right)^2 - .84\right] = \underline{0.5'}$

b) NOMINAL BOTTOM CLEARANCE — USE 2'

c) ROLL - B = BEAM ; S = 6° (see class 8 vessel calculations)

$Y = \frac{1}{2}(B)\sin\Theta = \frac{1}{2}(75)\sin 6° = \underline{3.9'}$

d) PITCH & HEAVE

PITCH = $\frac{\Theta L}{2}$ = 0.1H

$\frac{\Theta L}{2}$ + HEAVE = 2(0.1)(H) = 2(0.1)(8)

$\frac{\Theta L}{2}$ + HEAVE = $\underline{1.6'}$

THE ROLL REQUIREMENT GOVERNS OVER THIS PITCH & HEAVE VALUE.

e) REQUIRED DEPTH IN THE LAKE APPROACH & ENTRANCE CHANNELS AT SOUTH ENTRANCE FOR CLASS 7 VESSELS (700'-730' x 75'):

CASE 1 - UTILIZES SQUAT VALUE FROM GRAPHICAL METHOD
CASE 2 - UTILIZES SQUAT VALUE FROM EMPIRICAL METHOD

	CASE 1	CASE 2
STATIC DRAFT	25.5	25.5
SQUAT	0.4	0.5
ROLL	3.9	3.9
PITCH & HEAVE	—	—
NOMINAL CLEARANCE	2.0	2.0
REQUIRED DEPTH	31.8	31.9

USE A CHANNEL DEPTH REQUIREMENT OF $\underline{32'}$ BELOW LWD IN THE LAKE APPROACH CHANNEL AND ENTIRE ENTRANCE CHANNEL.

4) CLASS 6 VESSELS (650'-699' x 72')

a) SQUAT - GRAPHICAL METHOD

$A = 72' \times 25.5' = 1836\ ft^2$

$W = 600'$

$H = 32'$ (assumed)

$S = \frac{A}{WH} = \frac{1836}{600(32)} = 0.10$

$V = 8.8\ ft/s$; $g = 32.2\ ft/sec^2$

$F = \frac{V}{(gH)^{1/2}} = \frac{8.8}{[(32.2)(32)]^{1/2}} = 0.27$

$D = \frac{z}{H} = 0.012$ (from Figure A10)

$z = .012(32) = \underline{0.4'}$

SQUAT - EMPIRICAL METHOD

$V_1 = 8$ ft/sec ; $A_1 = 19{,}200\ ft^2$; $A_2 = 1836\ ft^2$

$A_w = 19{,}200 - 1836 = 17{,}364$; $g = 32.2\ ft/sec^2$

$$S = \frac{V_1^2}{2g}\left[\left(1.01\frac{A_1}{A_w}\right)^2 - 0.34\right]$$

$$S = \frac{8^2}{2(32.2)}\left[\left(1.01\frac{19{,}200}{17{,}364}\right)^2 - 0.34\right] = \underline{\underline{0.5'}}$$

b) NOMINAL BOTTOM CLEARANCE : USE 2.0'

c) ROLL - B - BEAM = 72' ; $\theta = 6°$ (see class 8 vessel calculations)

$$Y = \tfrac{1}{2} B \sin\theta = \tfrac{1}{2}(72')(\sin 6°) = \underline{3.8}$$

d) PITCH & HEAVE

$$\text{PITCH} = \frac{\theta L}{2} = 0.1 H \qquad \frac{\text{HEAVE}}{H} = 0.1$$

WHERE H - WAVE AMPLITUDE = 8.0'

$$\frac{\theta L}{2} + \text{HEAVE} = (2)(0.1)(H) = 2(0.1)(8)$$

$$\frac{\theta L}{2} + \text{HEAVE} = 1.6'$$

ROLL REQUIREMENT GOVERNS OVER THIS PITCH & HEAVE VALUE

e) REQUIRED DEPTH IN THE LAKE APPROACH AND ENTRANCE CHANNELS AT THE SOUTH ENTRANCE FOR THE CLASS 6 VESSELS (650'-699' x 72'):

CASE 1 - UTILIZES THE SQUAT VALUE FROM GRAPHICAL METHOD

CASE 2 - UTILIZES THE SQUAT VALUE FROM EMPIRICAL METHOD

	CASE 1	CASE 2
STATIC DRAFT	25.5	25.5
SQUAT	.4	.5
ROLL	3.8	3.8
PITCH & HEAVE	–	–
NOMINAL CLEARANCE	2.0	2.0
REQUIRED DEPTH	31.7	31.8

USE A CHANNEL DEPTH REQUIREMENT OF 32' BELOW LWD IN THE LAKE APPROACH CHANNEL AND ENTRANCE CHANNEL.

5) CLASS 5 VESSELS (600'-649'x68')

a) SQUAT - GRAPHICAL METHOD

$A = 68' \times 25.5' = 1734\ ft^2$

W = CHANNEL WIDTH = 600'

H - CHANNEL WATER DEPTH = 32'

$S = \frac{A}{WH} = \frac{1734\ ft^2}{(600)(32)} = 0.09$

V = 6 mph = 8.8 ft/sec

g = ACCELERATION OF GRAVITY = $32.2\ ft/sec^2$

$F = \frac{V}{(gH)^{1/2}} = \frac{8.8}{((32.2)32)^{1/2}} = 0.27$

$D = \frac{Z}{H} = 0.009$ (from Figure A10)

$Z = 0.009(32) = \underline{0.3'}$

SQUAT - EMPIRICAL METHOD

$V_1 = 6$ mph $= 8.8$ ft/sec

$A_1 = 600' \times 32' = 19{,}200\ ft^2$

$A_2 = 68' \times 25.5' = 1734\ ft^2$

$A_w = 19{,}200 - 1734 = 17{,}466\ ft^2$

$g = 32.2\ ft/sec^2$

$S = \frac{V_1^2}{2g}\left[\left(1.01\frac{A_1}{A_w}\right)^2 - .84\right]$

$S = \frac{(8.8)^2}{2(32.2)}\left[\left(1.01\frac{19{,}200}{17{,}466}\right)^2 - .84\right] = \underline{0.5'}$

b) NOMINAL BOTTOM CLEARANCE - USE 2'

c) ROLL : Y - DEPTH REQUIREMENT DUE TO ROLL

B - VESSEL BEAM = 68'

Θ = MAXIMUM ROLL IN DEGREES = 6°

$Y = \frac{1}{2} B \sin\Theta = \frac{1}{2}(68') \sin 6° = \underline{3.6'}$

d) PITCH & HEAVE

$PITCH = \frac{\theta L}{2} = 0.1H \quad \frac{HEAVE}{H} = 0.1$

WHERE H = WAVE AMPLITUDE = 8.0'

$\frac{\theta L}{2}$ + HEAVE $= (2)(0.1)(H) = (2)(0.1)(8) = 1.6'$

e) REQUIRED DEPTH IN THE LAKE APPROACH & ENTRANCE CHANNELS AT THE SOUTH ENTRANCE FOR THE CLASS 5 VESSELS (600'-649'x68'):

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CASE 1 - UTILIZES SQUAT VALUE FROM GRAPHICAL METHOD
CASE 2 - UTILIZES SQUAT VALUE FROM EMPIRICAL METHOD

	CASE 1	CASE 2
STATIC DRAFT	25.5	25.5
SQUAT	0.3	0.5
ROLL	3.6	3.6
PITCH & HEAVE	—	—
NOMINAL CLEARANCE	2.0	2.0
REQUIRED DEPTH	31.4	31.6

USE AN ENTRANCE DEPTH REQUIREMENT OF 32' BELOW LWD IN THE LAKE APPROACH CHANNEL & THE ENTIRE ENTRANCE CHANNEL.

B) NORTH ENTRANCE PLAN

1) CLASS 5 Vessels (600'-649' x 68')

The northern lake approach and entrance channels are located in an area where the lake bottom is rock. Therefore, the nominal bottom clearance requirement is 3.0 feet which is 1-foot greater than the allowance at the south entrance. The difference in the nominal bottom clearance requirement is the only change in the depth requirement between the north and south entrances for the Class 5 vessels. The required depth in the north lake approach and entrance channels is summarized below:

Case 1 - utilizes squat value from Graphical Method
Case 2 - utilizes squat value from Empirical Method

	Case 1	Case 2
Static Draft	25.5	25.5
Squat	0.3	0.5
Roll	3.6	3.6
Pitch and Heave	-	-
Nominal Clearance	3.0	3.0
Required Depth	32.4	32.6

Use an entrance depth requirement of 33 feet below LWD in the north lake approach and entrance channels

C) OUTER HARBOR CHANNELS

1) SOUTH OUTER HARBOR CHANNEL

CLASS 10 VESSELS (950'-1000' × 105'):

a) SQUAT - GRAPHICAL METHOD

$A = 105' \times 25.5' = 2677.5\ ft^2$

$W = 1400'$

$H = 30'$ (assumed)

$S = \frac{A}{WH} = \frac{2677.5}{(1400)(30)} = 0.06$

$V = 3\ mph = 4.4\ ft/sec$

$g = 32.2\ ft/sec^2$

$F = \frac{V}{(gH)^{1/2}} = \frac{4.4}{((32.2)(30))^{1/2}} = 0.14$

$D = \frac{Z}{H} = 0.001$ (From Figure A10)

$Z = (0.001)(30) = 0.03$ feet

SQUAT - EMPIRICAL METHOD

$V_1 = 4.4$ fps

$A_1 = 1400 \times 30 = 42{,}000\ ft^2$

$A_2 = 105 \times 25.5 = 2677.5\ ft^2$

$A_w = A_1 - A_2 = 42{,}000 - 2677.5 = 39{,}322.5\ ft^2$

$g = 32.2\ ft/sec^2$

$S = \frac{V_1^2}{2g}\left[\left(1.01\frac{A_1}{A_w}\right)^2 - 0.84\right]$

$S = \frac{(4.4)^2}{(2)(32.2)}\left[\left(1.01\left(\frac{42000}{39322.5}\right)\right)^2 - 0.84\right] = 0.10$ feet

b) NOMINAL BOTTOM CLEARANCE

Use 2.0 Feet since channel bottom is soft

c) ROLL

A 1,000-foot long vessel can be expected to roll up to 2 to 3 degrees as the vessel turns into the south outer harbor channel. This analysis will use 2-½ degrees.

$Y = \frac{B}{2}\sin\theta = \frac{105}{2}\sin(2\text{-}1/2^\circ) = 2.3$ feet

d) PITCH AND HEAVE - A 1,000-foot long vessel will not experience pitch and heave in the Outer Harbor Channels

e) Required Depth in the south Outer Harbor channel for the south entrance plan by 1,000-foot long vessels (950' - 1,000 x 105'):

Case 1 utilizes squat value from Graphical Method
Case 2 utilizes squat value from Empirical Method

	Case 1	Case 2
Static Draft	25.5	25.5
Squat	0.0	0.1
Roll	2.3	2.3
Pitch and Heave	—	—
Nominal Clearance	2.0	2.0
Required Depth	29.8	29.9

Use a channel depth of 30 feet below LWD in the south Outer Harbor channel.

2) MIDDLE OUTER HARBOR CHANNEL

Once vessels enter the Middle Outer Harbor Channel, the south breakwater will provide protection against waves and vessels would not experience any roll. Therefore, the depth requirement for the Middle Outer Harbor Channel consists of only the vessel draft, squat and nominal bottom clearance requirements. The required depth in the Middle Outer Harbor Channel is summarize below:

Static Draft	25.5
Squat	0.1
Roll	0.0
Pitch and Heave	0.0
Nominal Clearance	2.0
Required Depth	27.6

Use a depth requirement of 28 feet below LWD in the Middle Outer Harbor Channel.

3) NORTH OUTER HARBOR CHANNEL

Class 5 Vessels (600'-649' x 68')

a) SQUAT- GRAPHICAL METHOD

$A = 68' \times 25.5' = 1734 \text{ ft}^2$

$W = 400$ feet

$H = 31$ ft

$$S = \frac{A}{WH} = \frac{1734}{(400)(31)} = 0.14$$

$V = 3 \text{ mph} = 4.4 \text{ ft/sec}$

$g = 32.2 \text{ ft/sec}^2$

$$F = \frac{V}{(gH)^{1/2}} = \frac{4.4}{[(32.2)(31)]^{1/2}} = 0.14$$

$$D = \frac{Z}{H} = 0.005 \text{ (From Figure A10)}$$

$$Z = 0.005H = 0.005(31) = 0.1 \text{ ft}$$

SQUAT- EMPIRICAL METHOD

$V_1 = 3 \text{ mph} = 4.4 \text{ ft/sec}^2$

$A_1 = 400 \times 31 = 12{,}400 \text{ ft}^2$

$A_2 = 68' \times 25.5 = 1734 \text{ ft}^2$

$A_w = 12{,}400 - 1734 = 10{,}666 \text{ ft}^2$

$g = 32.2 \text{ ft/sec}^2$

$$S = \frac{V_1^2}{2g}\left[\left(1.01 \frac{A_1}{A_w}\right)^2 - 0.84\right]$$

$$S = \frac{(4.4)^2}{(2)(32.2)}\left[\left(1.01 \frac{12{,}400}{10{,}666}\right)^2 - 0.84\right] = 0.2 \text{ feet}$$

b) NOMINAL BOTTOM CLEARANCE

USE 3.0 feet for hard material

c) ROLL

A Class 5 Vessel can be expected to roll up to 3 to 5 degrees as the vessel turns into the north Outer Harbor channel. This analysis will use 4-degrees.

$$Y = \frac{B}{2}\sin\theta = \frac{68}{2}\sin 4° = 2.4 \text{ feet}$$

d) PITCH AND HEAVE - Vessels up to Class 5 will not experience pitch and heave in the North Outer Harbor Channel.

e) Required depth in the North Outer Harbor Channel for vessels up to Class 5 is summarized below:

Case 1 utilizes squat value from Graphical Method
Case 2 utilizes squat value from Empirical Method

	Case 1	Case 2
Static Draft	25.5	25.5
Squat	0.1	0.2
Roll	2.4	2.4
Pitch and Heave	–	–
Nominal Clearance	3.0	3.0
Required Depth	31.0	31.1

Use a channel depth of 31 feet below LWD in the North Outer Harbor channel

D) BUFFALO RIVER DEEPENING

1) Class 5 Vessels (630 feet x 68 feet)

a) SQUAT - GRAPHICAL METHOD

$A = 68 \times 25.5 = 1734 \text{ ft}^2$

$W = 100 \text{ ft}$ = minimum width on river

$H = 28$ feet

$$S = \frac{A}{WH} = \frac{1734}{(100)(28)} = 0.62$$

$V = 2 \text{ mph} = 2.93 \text{ ft/sec}$

$g = 32.2 \text{ ft/sec}^2$

$$F = \frac{V}{(gH)^{1/2}} = \frac{2.93}{((32.2)(28))^{1/2}} = 0.10$$

$D = \frac{Z}{H} = 0.01$ (the value for S exceeds the value for S in Figure A15, however the upper value in the Figure will be used)

$Z = 0.01 \; (28) = 0.3$

SQUAT - EMPIRICAL METHOD

$V_1 = 2 \text{ mph} = 2.93 \text{ ft/sec}$

$A_1 = 100 \times 28 = 2800 \text{ ft}^2$

$A_2 = 68 \times 25.5 = 1734 \text{ ft}^2$

$A_w = A_1 - A_2 = 2800 - 1734 = 1066 \text{ ft}^2$

$g = 32.2 \text{ ft/sec}^2$

$$S = \frac{V_1^2}{2g}\left[\left(1.01 \; \frac{A_1}{A_w}\right)^2 - 0.84\right]$$

$$S = \frac{(2.93)^2}{2(32.2)}\left[\left(1.01 \; \frac{2800}{1066}\right)^2 - 0.84\right] = 0.8 \text{ feet}$$

Use a squat value of 0.8 ft in the depth requirement

b) Nominal Bottom Clearance

Use 2.0 feet in soft material and 3.0 feet in hard material

c) Vessel Roll

The amount of vessel roll on the Buffalo River would be insignificant. A vessel on the river would not encounter waves parallel to its hull to cause the vessel to roll. Wind on the side of the vessel may cause an insignificant amount of roll. A vessel equiped with sidethrusters and traveling

at 2 mph would probably not experience any roll while making a turn in a bend of the river. Therefore, use 0.0 feet for vessel roll requirement.

d) Pitch and Heave

A vessel traveling on the Buffalo River would not encounter waves with a sufficient wave length to cause the vessel to experience pitch or heave. Therefore, use 0.0 feet for vessel pitch and heave requirement.

e) Required Depth in the Buffalo River

Case 1 utilizes squat value from Graphical Method
Case 2 utilizes squat value from Empirical Method

	Case 1	Case 2
Static Draft	25.5	25.5
Squat	0.3	0.8
Roll	0.0	0.0
Pitch and Heave	0.0	0.0
Nominal Clearance	2.0	2.0
Required Depth	27.8	28.3

Use a river channel depth of 28 feet below LWD on the Buffalo River

Hudson's Formula:

$$W = \frac{w_r H^3}{K_D (S_r - 1)^3 \cot\theta}$$

$w_r = 160$ lb/ft^3
$H = 6.0$ feet (breaking)
$K_D = 3.5$
$S_r = 160/62.4 = 2.56$
$\cot\theta = 3.0$

$$W = \frac{(160)(6.0)^3}{(3.5)(2.56-1)^3(3)} = 867 \text{ lbs}$$

Armor Stone

$W_{max} = 2.0\,W = 2(867) = 1734$ lbs
$W_{min} = 0.9\,W = 0.9(867) = 780$ lbs

Thickness of Armor Layer

$$r = n\, k_\Delta \left(\frac{W}{w_r}\right)^{1/3}$$

$n = 2$ stones
$k_\Delta = 1.15$
$W = 867$ lbs
$w_r = 160$ lb/ft^3

$$r = (2)(1.15)\left(\frac{867}{160}\right)^{1/3} = 4.04 \text{ feet}$$

Use $r = 4.0$ feet

UNDERLAYER STONE

$W_{max} = 0.2\,W = (0.2)(867) = 173$ lbs
$W_{min} = 0.06\,W = (0.06)(867) = 52$ lbs

Thickness of Underlayer

$$r = n\, k_\Delta \left(\frac{.1W}{w_r}\right)^{1/3}$$

$n = 2$ stones
$k_\Delta = 1.15$
$.1W = 86.7$ lbs
$w_r = 160$ lbs/ft^3

$r = (2)(1.15)\left(\frac{87.6}{160}\right)^{1/3} = 1.9$ feet   use 2.0 feet

BY YJG DATE 1/82 SUBJECT Buffalo Harbor, NY SHEET NO. 2E OF 2E
CHKD. BY [illegible] DATE 3/82 NFTA Small Boat Harbor JOB NO.
Dike Crest Elevation/Wave Runup

CETA 80-7 entitled "Estimation of Wave Transmission Coefficients for Overtopping of Impermeable Breakwaters" was used to estimate the wave runup on the armor faced slag dike:

$$\text{Wave Runup} = R = \left(\frac{a\,\mathcal{E}}{1+b\,\mathcal{E}}\right)H$$

where: a = runup coefficient = 0.692

b = runup coefficient = 0.504

$$\mathcal{E} = \frac{\tan\theta}{\sqrt{H/L_o}}$$

$\tan\theta$ = dike slope = 0.333

H = incident wave height = 6.0 feet

T_i = 9.8 seconds

$L_o = 5.12\,T^2 = 5.12(9.8)^2 = 491.7$ feet

$$\mathcal{E} = \frac{0.333}{\sqrt{6/491.7}} = 3.01$$

$$R = \frac{(0.692)(3.01)(6)}{1+(0.504)(3.01)} = 5.0 \text{ feet}$$

For Zero Overtopping Condition

H_{B_i} = DWL + R

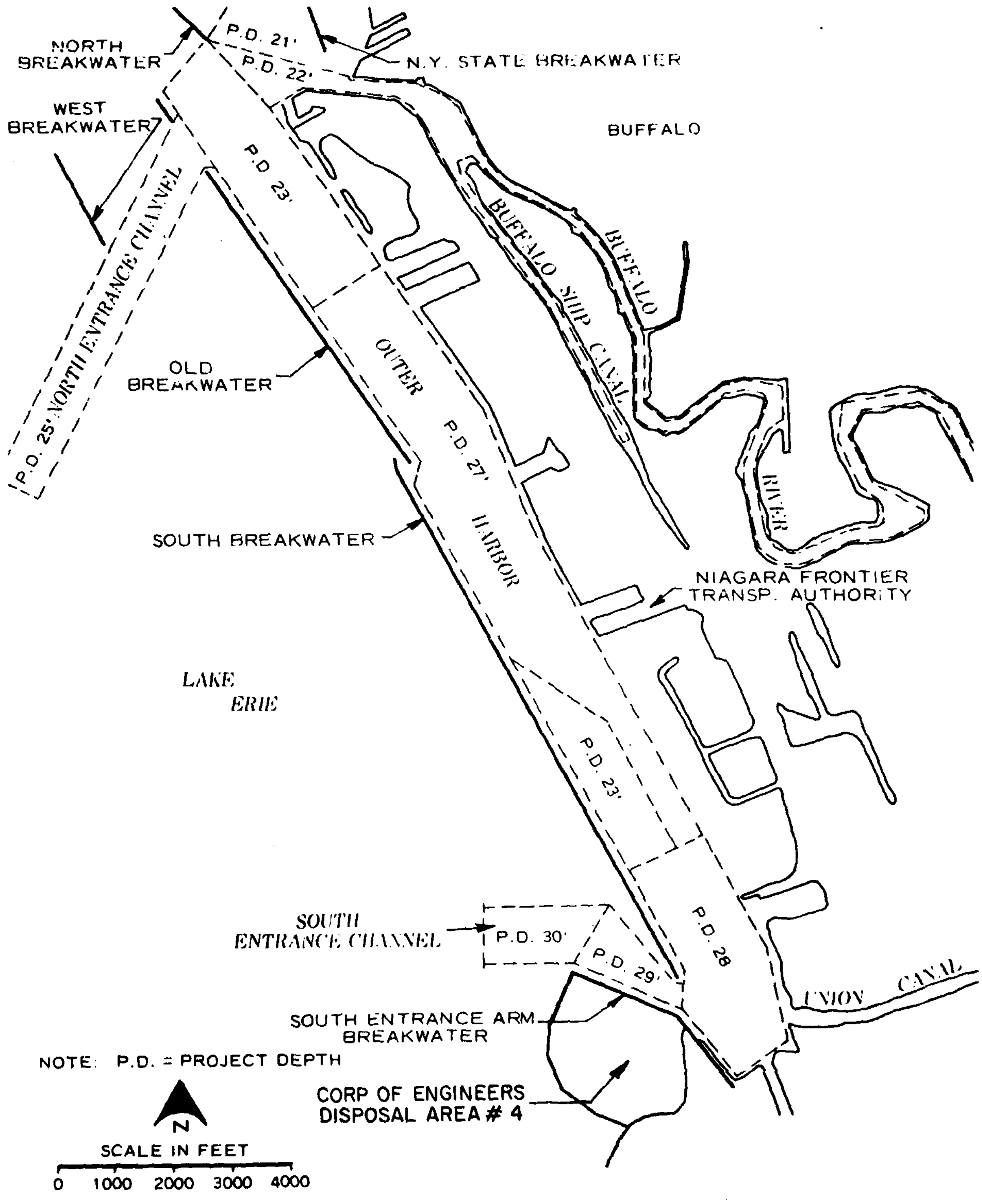
H_{B_i} = Crest Elevation of Dike

DWL = +9.0

R = 5.0 feet

H_{B_i} = 9.0 + 5.0 = 14.0 feet

Use 14.0 feet above LWD

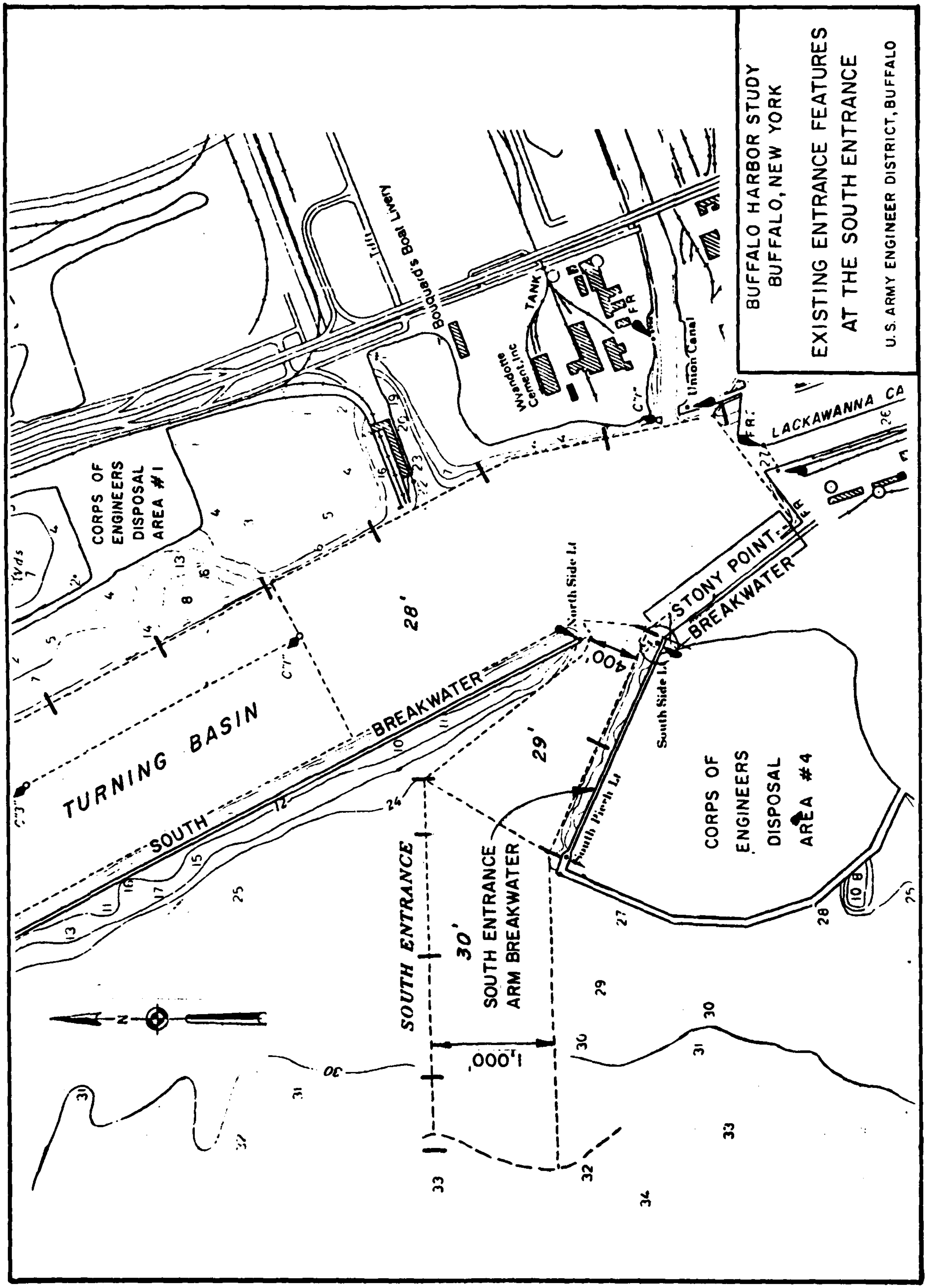


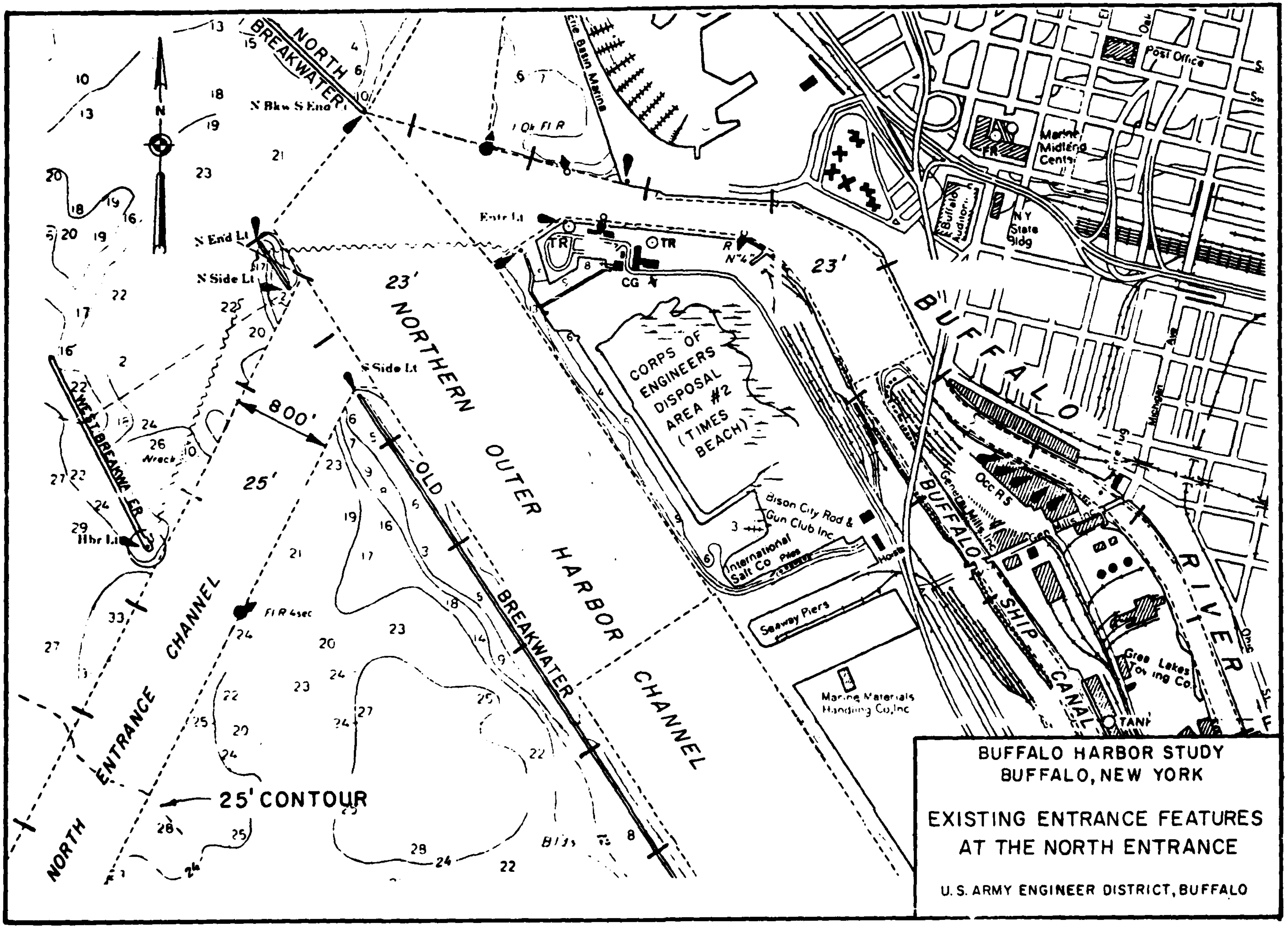
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

EXISTING BUFFALO HARBOR PLAN

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A1


BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
EXISTING ENTRANCE FEATURES
AT THE SOUTH ENTRANCE
U.S. ARMY ENGINEER DISTRICT, BUFFALO
CORPS OF ENGINEERS DISPOSAL AREA #1
CORPS OF ENGINEERS DISPOSAL AREA #4
TURNING BASIN
SOUTH BREAKWATER
STONY POINT BREAKWATER
SOUTH ENTRANCE
SOUTH ENTRANCE ARM BREAKWATER
LACKAWANNA CA
Bouquard's Boat Livery
Wyandotte Cement, Inc
TANK
Union Canal
North Side Lt
South Side Lt
South Pierh Lt
28'
29'
30'
400'
1,000'

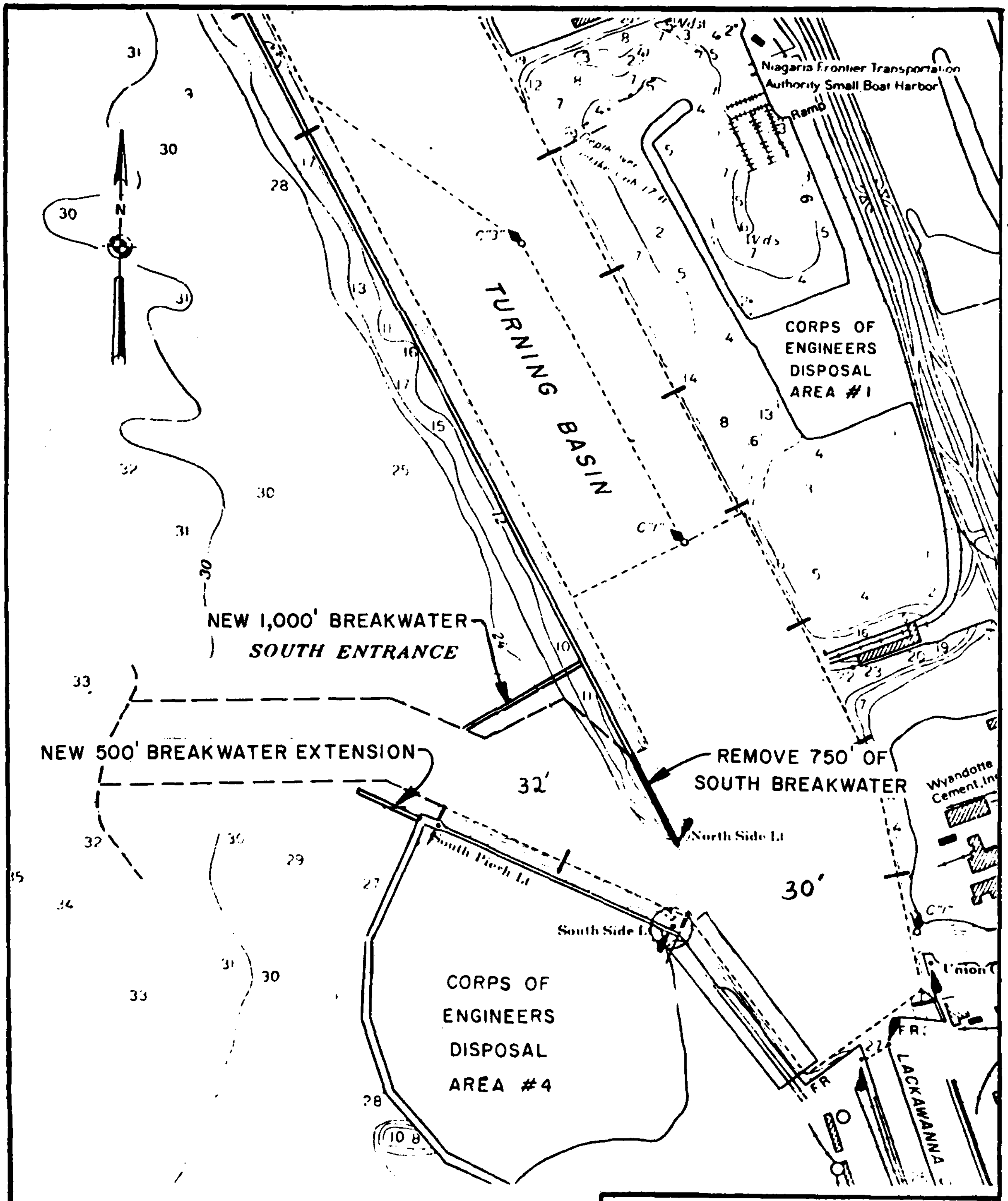


BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

EXISTING ENTRANCE FEATURES AT THE NORTH ENTRANCE

U.S. ARMY ENGINEER DISTRICT, BUFFALO

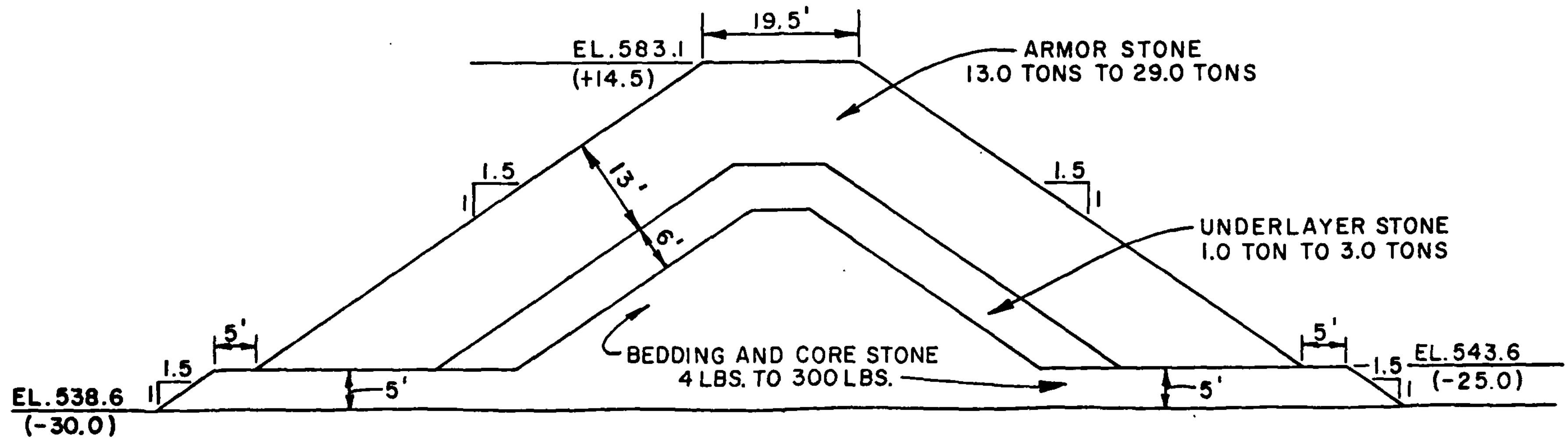
PLATE A3



BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

PROPOSED BREAKWATER CONCEPT
FOR SOUTH ENTRANCE PLAN

U.S. ARMY ENGINEER DISTRICT, BUFFALO



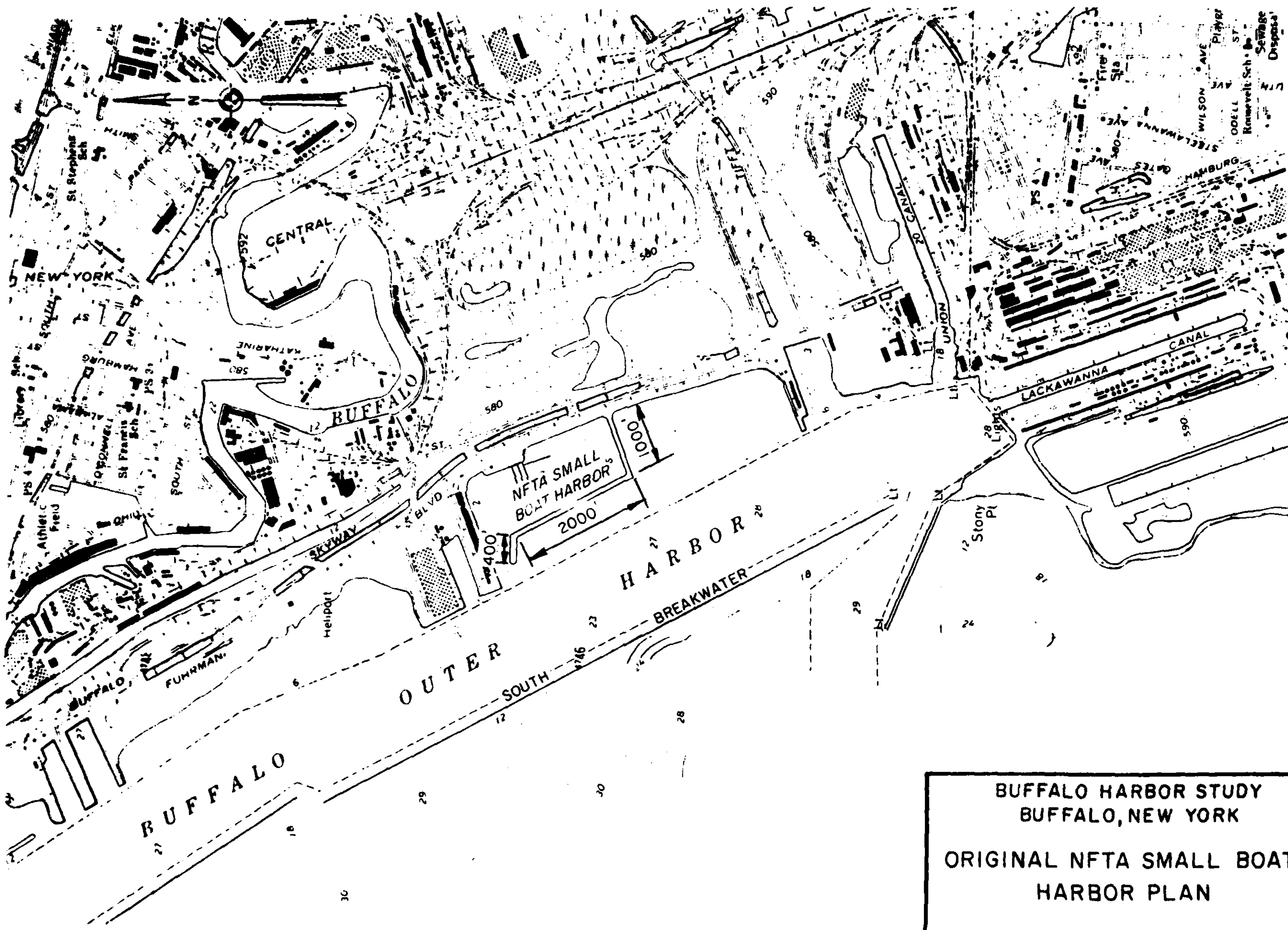
TYPICAL BREAKWATER SECTION

SCALE: 1" = 20'

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

TYPICAL BREAKWATER SECTION
FOR STRUCTURAL MODIFICATIONS

U. S. ARMY ENGINEER DISTRICT, BUFFALO

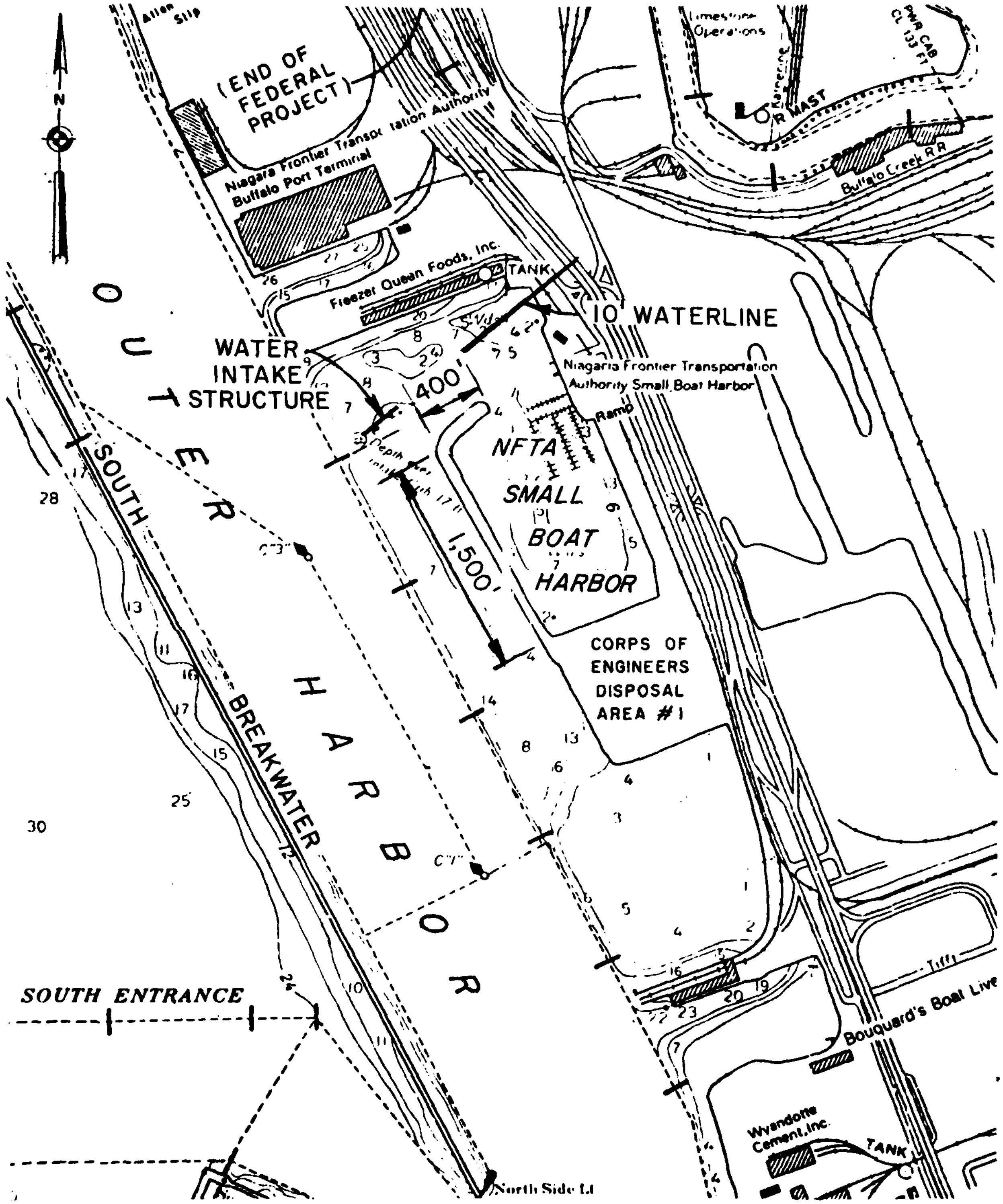


BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

ORIGINAL NFTA SMALL BOAT HARBOR PLAN

U. S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A6



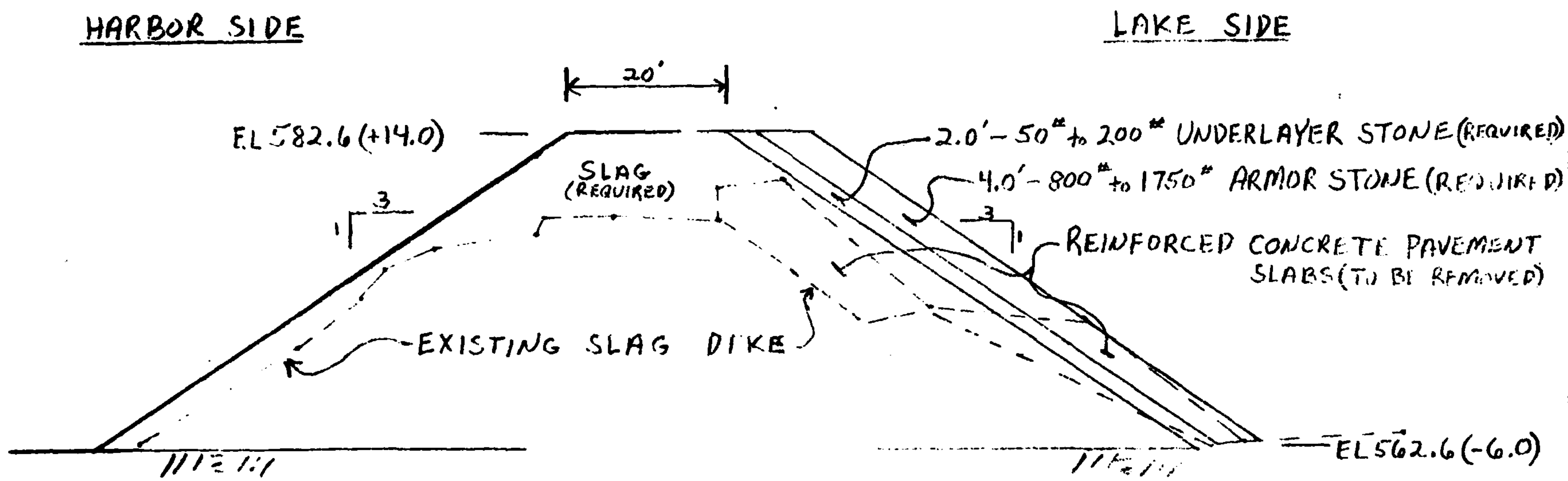
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

EXISTING NFTA SMALL BOAT HARBOR PLAN

U.S. ARMY ENGINEER DISTRICT, BUFFALO

PLATE A7

BY .... DATE .... SUBJECT .... Harbor, NY
CHKD. BY .... DATE .... NFTA Small Boat Harbor
SHEET NO. .... OF ....
JOB NO. ....

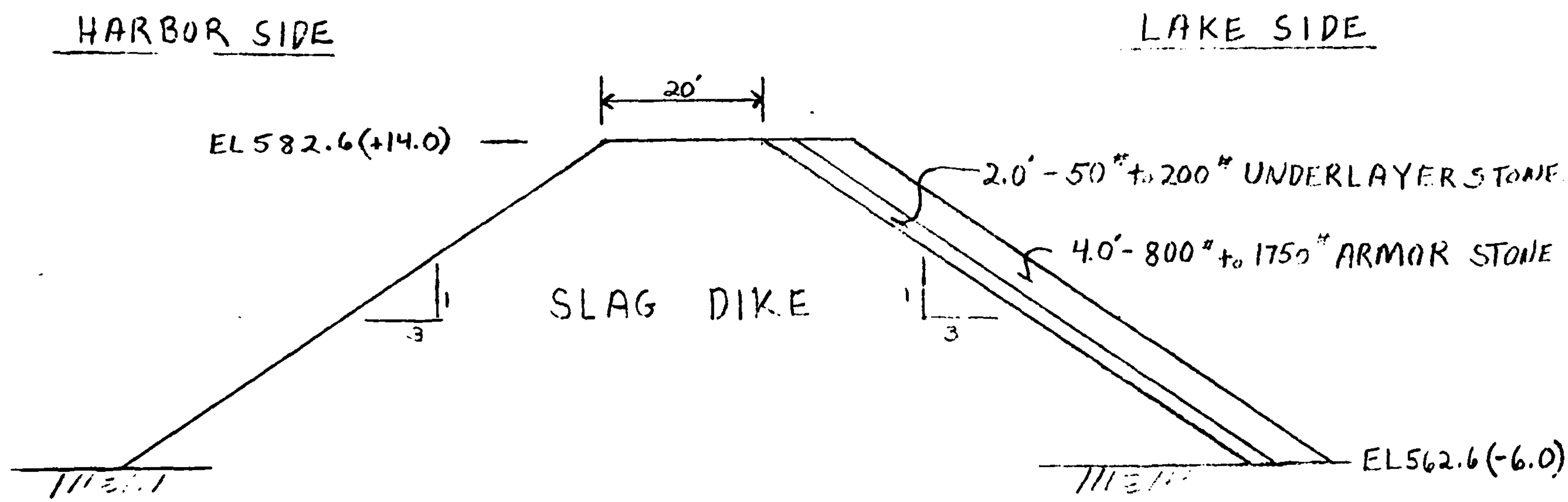


TYPICAL SECTION

EXISTING & RECOMMENDED SECTIONS
NFTA SMALL BOAT HARBOR DIKE
STA 0+00 - STA 15+00
Scale: 1" = 10.0' vertical
1" = 20.0' horizontal

PLATE A8

BY L.O. DATE ...... SUBJECT Outer Harbor, NY — NFTA Small Boat Harbor SHEET NO. ...... OF ......
CHKD. BY ...... DATE ...... JOB NO. ......



TYPICAL SECTION

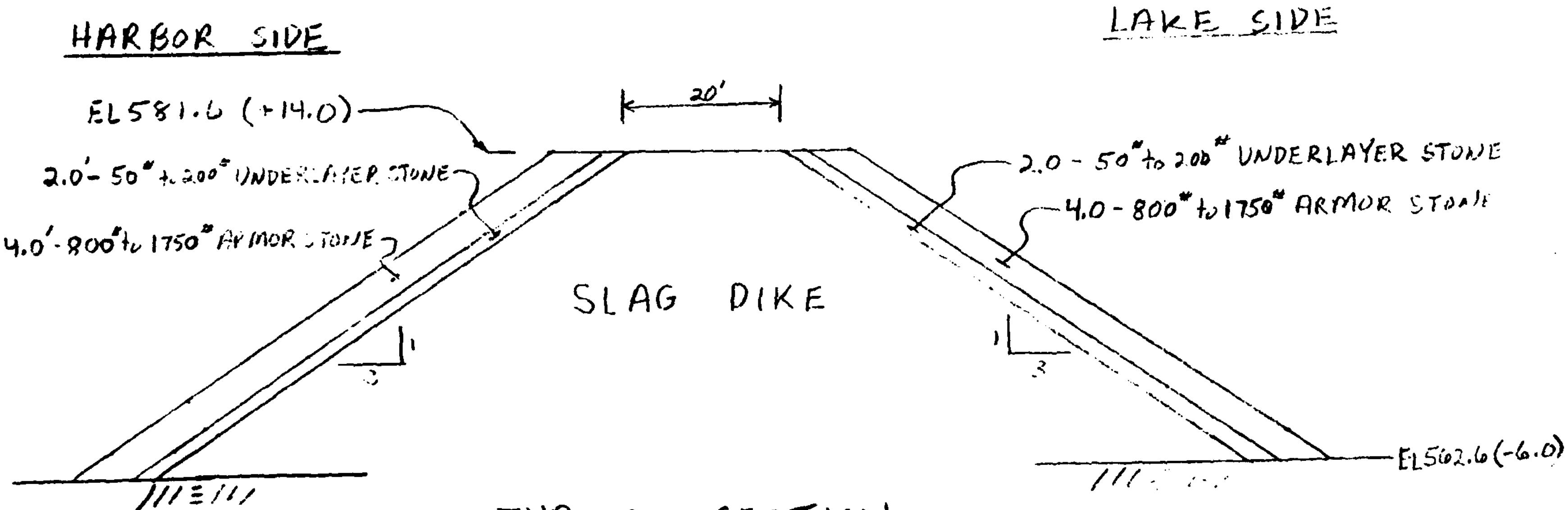
NFTA SMALL BOAT HARBOR DIKE IMPROVEMENTS

STA 15+00 – STA 20+00

Scale: 1" = 10.0' vertical
1" = 20.0' horizontal

PLATE A9

BY .... DATE .... SUBJECT .... Harbor, N.Y. .... SHEET NO. .... OF ....
CHKD. BY .... DATE .... NFTA Small Boat Harbor .... JOB NO. ....



TYPICAL SECTION

NFTA SMALL BOAT HARBOR DIKE IMPROVEMENTS

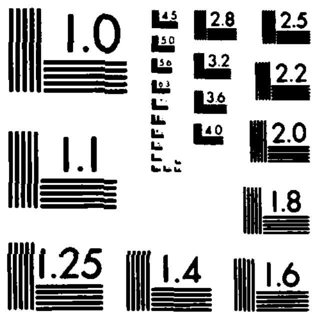
STA 20+00 - STA 24+00

Scale: 1" = 10.0' vertical
1" = 20.0' horizontal

PLATE A 10

AD-A129 189 BUFFALO HARBOR STUDY PRELIMINARY FEASIBILITY REPORT VOLUME II APPENDICES(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT APR 83 2/8

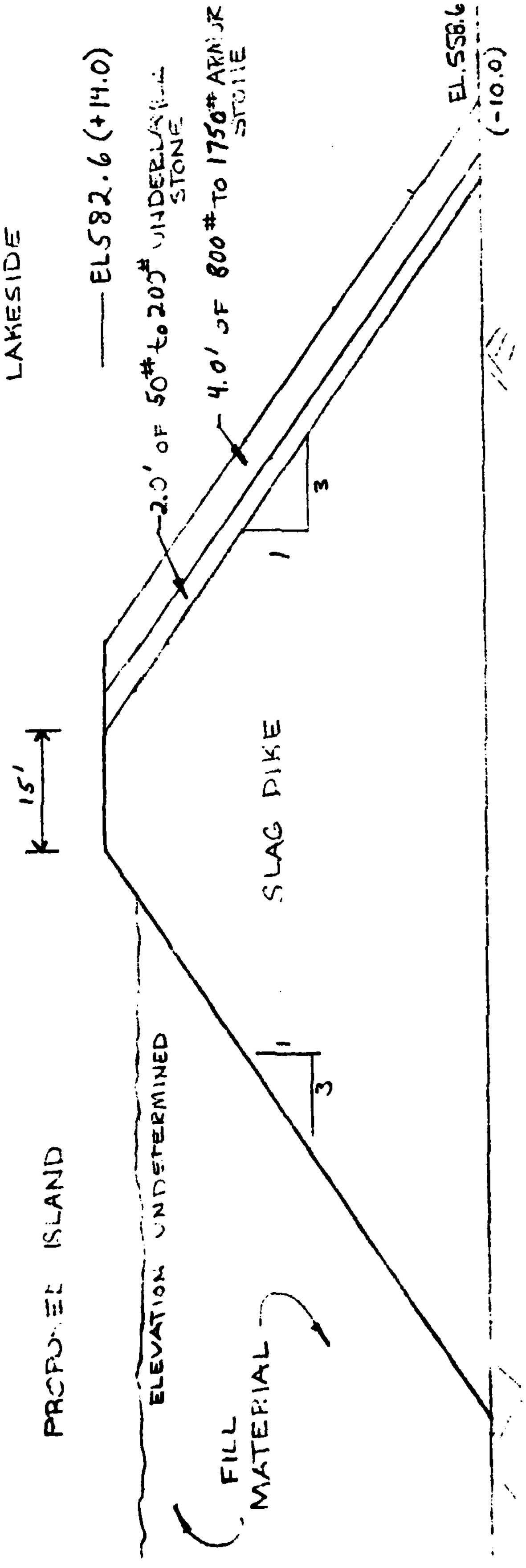
UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

BY [illegible] DATE 7/27/82 SUBJECT Buffalo Harbor, NY SHEET NO. ____ OF ____

CHKD. BY ____ DATE ____ JOB NO ____

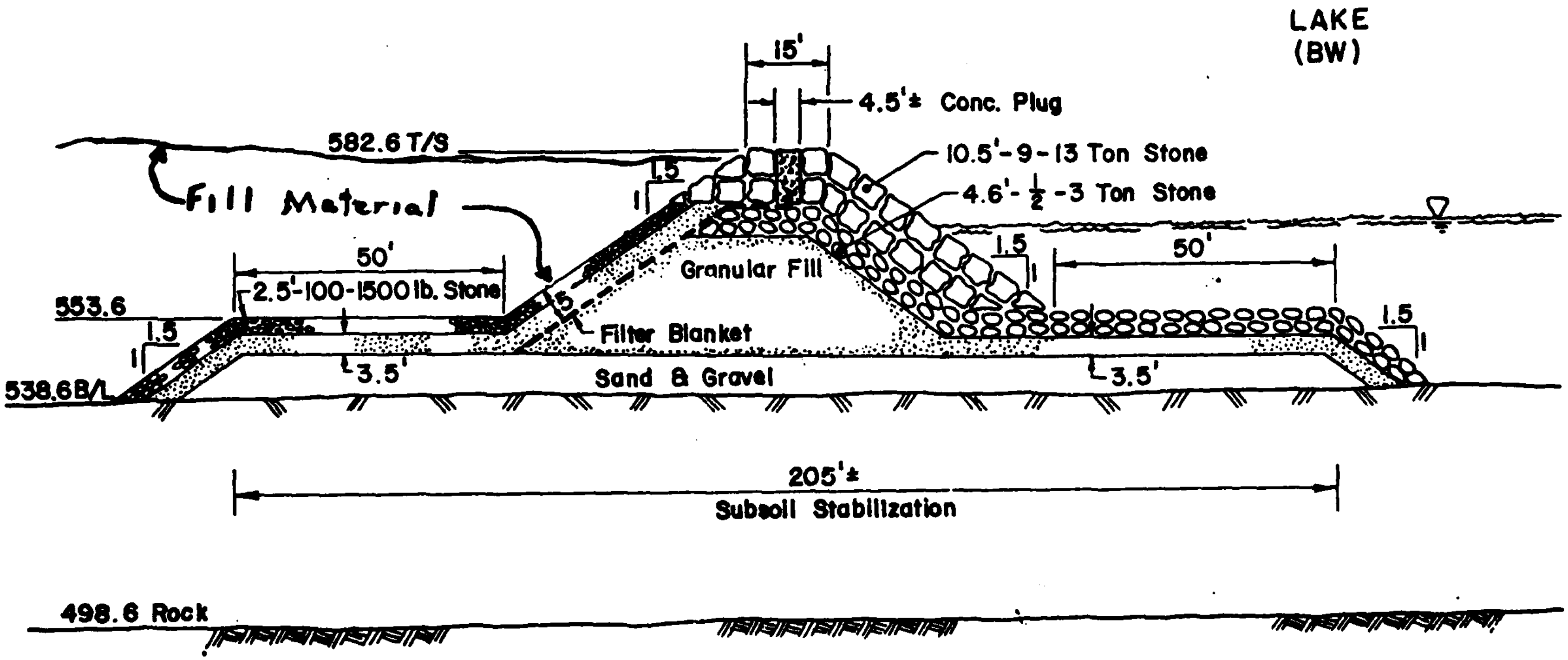


TYPICAL CROSS SECTION

OFFSHORE ISLAND PROTECTION at 10-FOOT BOTTOM DEPTH

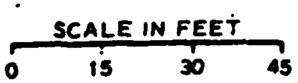
Scale: 1" = 10.0' Vertical
1" = 20.0' Horizontal

PLATE A1[illegible]



TYPICAL SECTION

Offshore Island Protection
at 30-Foot Bottom Depth



APPENDIX B
ECONOMIC EVALUATION

BUFFALO HARBOR, NY

STAGE II
PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

BUFFALO HARBOR PRELIMINARY FEASIBILITY REPORT
ECONOMIC EVALUATION
APPENDIX B

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BUFFALO HARBOR PRELIMINARY FEASIBILITY REPORT

ECONOMIC EVALUATION

APPENDIX B

SECTION 1 - COMMERCIAL NAVIGATION

B1. ECONOMIC STUDY AREA

a. Physical Description.

Buffalo Harbor is located in the city of Buffalo, Erie County, New York. The harbor is positioned at the eastern end of Lake Erie at the head of the Niagara River. The port is approximately 176 statute miles northeast of Cleveland, Ohio, and 22 miles east of Port Colborne, Ontario, Canada - the Lake Erie terminus of the Welland Canal.

The harbor consists of a lakefront, breakwater, protected Outer Harbor, and an Inner Harbor which includes the Buffalo River and the Buffalo Ship Canal.

The Outer Harbor extends along the Buffalo lakefront for a distance of about 4 miles. It has a width of 1,600 feet formed by a breakwater system parallel to the lakeshore, extending from Stony Point to the head of the Niagara River. There are two dredged entrance channels located at the northern and southern extremities of the Outer Harbor. These channels are known as the North and South Entrance Channels and are approximately 3 miles apart.

The Buffalo River entrance channel extends from the Outer Harbor, opposite the North Entrance channel, to a turning basin at the junction of the Buffalo River and the Buffalo Ship Canal. The channel narrows in width from 1,300 feet in the Outer Harbor to 230 feet at the lakeward end of a bulkhead on the north side of the entrance. The channel then widens to 670 feet in the turning basin.

The improved section of the Buffalo River extends approximately 5.3 miles upstream from the Buffalo River mouth to the upper Consolidated Rail Corporation Bridge. River channel widths in the area vary from 100 to 700 feet.

The Buffalo Ship Canal extends from the basin at the mouth of the Buffalo River southeast approximately 1.5 miles. The channel width has been improved to 125 feet.

Figure 1 depicts the various elements of the Buffalo Harbor Federal project with its corresponding project limits and dimensions.

b. Historical Development.

(1) Introduction - Initial interest in the establishment of the city of Buffalo, originally called New Amsterdam, came from a desire for a port location on Lake Erie in western New York State. A port was desired as a

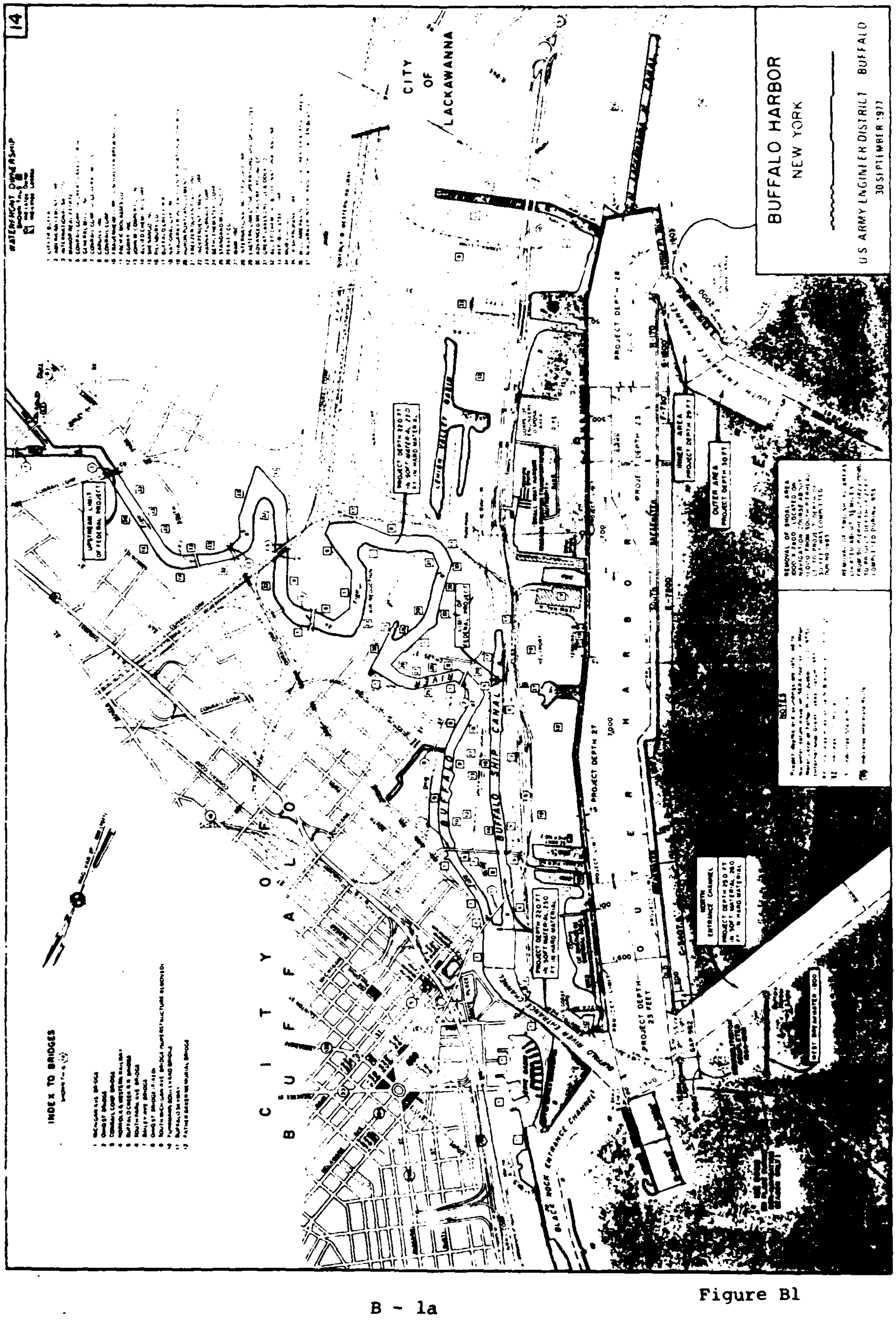

14
BUFFALO HARBOR
NEW YORK
U.S. ARMY ENGINEER DISTRICT BUFFALO
30 SEPTEMBER 1977
CITY OF LACKAWANNA
CITY OF BUFFALO
INDEX TO BRIDGES
WATERFRONT OWNERSHIP
OUTER HARBOR
BUFFALO SHIP CANAL
BUFFALO RIVER
LEHIGH VALLEY BASIN
UPSTREAM LIMIT OF FEDERAL PROJECT
NORTH ENTRANCE CHANNEL
BLACK ROCK ENTRANCE CHANNEL
OUTER AREA
INNER AREA
NOTES

Figure B1

possible western terminus of the then proposed Erie Canal, which was to link the region west of the Appalachians to population and market centers along the east coast.

The removal of a sand bar at the mouth of the Buffalo River in 1820 led to the selection of Buffalo as the western terminus of the Erie Canal, which was opened in 1825. Improvements to the Erie Canal and Buffalo River during the following quarter century induced substantial growth in waterborne traffic. By 1842, Buffalo was connected to Albany by rail and the importance of transshipment and break-of-bulk activities enhanced the economic base of Buffalo. Policies which prohibited cargo movement by railroad routes parallel to the Erie Canal were removed in 1850 and the community began to experience rapid economic and population growth. The growth of rail shipments resulted in the decline of waterborne commerce via the Erie Canal in the latter part of the nineteenth century. It was in this period that Buffalo developed as a center for the grain milling industry.

(2) Grain Industry - With the advent of the Erie Canal in 1825, the importance of Buffalo as a grain transshipment center grew. Grain shipped from the upper midwest via the Great Lakes to Buffalo increased from 112,000 bushels in 1835 to 2 million bushels in 1841. The first commercially successful grain elevator with mechanical unloading and storage of grain was built in Buffalo in 1842. By 1860, Buffalo had 10 mechanized grain elevators and the city had replaced Rochester as the leading flour milling center in the country. By 1875, Buffalo had grown to be the world's leading grain port with all wheat grown east of the Rockies passing through its facilities. Two hundred million bushels of grain were moved through the port of Buffalo in 1900.

(3) Steel Industry - The steel industry grew in the latter part of the nineteenth century due to the industrialization spurred by the Civil War and the expanding national economy. The steel industry began in Buffalo with the opening of one blast furnace in 1860. The major steel plant in Buffalo today, Bethlehem Steel, opened in 1903 and marked the development of the Great Lakes as a prime area for the steel industry to locate in. A Great Lakes location provided access to low cost water transportation to satisfy the increasing demand for iron ore and limestone. It also provided access to coking quality coal located in the Appalachian region and to the expanding industrial markets of the northeast and midwest. Steel production continued to increase in Buffalo until it achieved a maximum output of 7.7 million tons of steel in 1966.

(4) The Port in the Twentieth Century - Buffalo grew and expanded its economic base well into the twentieth century due to the growth in the grain milling and steel industry. By the 1920's, Buffalo had become a major industrial production center as well as a transportation/distribution center. By 1925, the Port of Buffalo ranked second in terms of total tonnage handled among all Great Lakes ports and fifth among all U.S. ports. By 1945, even though port activity had increased, Buffalo's relative position among the Great Lakes ports had dropped to fourth, and to eighth among all the ports in the nation.

The impetus for the rapid expansion and settlement of Buffalo had been its location at the eastern-most point on the four upper Great Lakes. The opening of the St. Lawrence Seaway in 1959 reduced the need for an eastern terminus on the Great Lakes. The opening of the seaway, plus technological changes in land transportation and basic changes in the rail freight rate structure, combined to reduce traffic passing through the Port of Buffalo.

Prior to the opening of the Seaway, the Port of Buffalo handled approximately 19 million tons per year in 1957. By 1962, the tonnage had declined to approximately 13 million tons annually. While the Seaway was not the only factor responsible for this decline, it did have a significant negative impact. The opening of the Seaway allowed ocean vessels access to the Great Lakes, thereby eliminating the locational advantage of Buffalo as a transfer center for cargo shipped to the northeast and as a break-of-bulk point. With the opening of the Seaway, ocean vessels could carry grains directly to foreign countries and Great Lakes bulk freighters could navigate directly to the Gulf of St. Lawrence. This transportation alternative plus improvements in the Mississippi River and tributary waterways and the establishment of site-specific commodity rail rates for grain eliminated much of the advantage Buffalo had in processing grain. The consolidation of the grain industry in Buffalo continued while the tonnage of iron ore and limestone remained relatively constant. The ports total tonnage began to decline and never regained the level of waterborne commerce it had attained prior to the opening of the Seaway in 1959.

c. Problems and Plans.

The main navigation issue in Buffalo Harbor is to determine the extent to which modifications to the existing Federal project are justified. These modifications would allow a more safe and efficient use of large commercial vessels to move bulk commodities. Eight plans are evaluated; one North Entrance and seven South Entrance improvement alternatives. The North Entrance Plan would allow the passage of a 638-foot-long by 68-foot-wide vessel at a maximum operating draft of 22.5 feet through the North Entrance Channel to the Buffalo River or the Buffalo Ship Canal. Seven South Entrance improvement plans include breakwall modifications at the South Entrance and Outer Harbor Channel deepening to provide all vessels with adequate channel depths to safely enter the harbor during 30-knot winds and 8-foot waves at a 25.5 foot maximum operating draft. Three South Entrance Plans involved only harbor deepening. Two South Entrance Plans were transshipment alternatives originating from the Niagara Frontier Transportation Authority. The other two South Entrance Plans were transshipment alternatives originating from the Independent Cement Corporation site. A brief overview of these plans is presented in Table B1.

(1) Plan IId - A North Entrance improvement plan would allow Class 5 vessels up to 638 feet long to enter the Buffalo Ship Canal and navigate the first 2.5 miles of the Buffalo River at a maximum operating draft (MOD) of 22.5 feet. This plan allows vessels currently servicing these areas at less than their maximum carrying capacity to operate at greater drafts. Total transportation costs for commodities serviced by this area (grain, sand and gravel) are expected to decline.

Table B1 - Overview of Plans

Plan Alternative	Plan Description	Impact on Vessel Operations	Commodies Affected
IId - North Entrance Improvement	Deepen the North Entrance, the Buffalo Ship Canal, and the first 2.5 miles of the Buffalo River up to a maximum operating draft of 22.5 feet. Replacement of 7,960 lineal feet of bulkhead.	Class 5 Vessels up to 638 feet in length could enter the Buffalo River and Buffalo Ship Canal at a 22.5 maximum operating draft (MOD) via the North Entrance during 30-knot winds and 8-foot waves.	Grain Sand and Gravel
IIe - South Entrance Improvements with Deepening in the Outer Harbor, Buffalo River, and Buffalo Ship Canal	Deepen the South Entrance Channel to 32 feet. Deepen the Outer Harbor to 28 feet up to the Seaway piers, and deepen to 25 feet from the Seaway piers to 2.5 miles up the Buffalo River and to the end of the Federal project on the Buffalo Ship Canal. Replace 7,960 lineal feet of bulkhead. Remove 750 feet of the South Breakwater and build 1,000 feet of breakwall on the lake side of the South Breakwater. Also add 500 feet of breakwall to the South Entrance arm breakwall.	Vessels up to and including Class 10 could enter the Outer Harbor via the South Entrance during 30-knot winds and 8-foot waves at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to the NFTA Seaway piers. A 22.5-foot MOD extends from the Seaway piers to 2.5 miles up the Buffalo River and to the end of the Federal project in the Buffalo Ship Canal.	Grain Sand and Gravel Iron Ore Limestone
IIIf - Shuttle Vessel Transshipment of Iron Ore from NFTA Seaway Piers	Deepen the South Entrance Channel to 32 feet. Deepen the Outer Harbor to 28 feet from the end of the Lackawanna Canal to 3,500 feet south of NFTA Seaway Pier No. 2. Remove 750 feet of the south breakwater. Construction of 1,000 feet of breakwall on the lake side of the south breakwater. Also add 500 feet of breakwall to the South Entrance arm breakwall. Development of an iron ore shuttle vessel transshipment facility at NFTA.	Vessels up to and including Class 10 able to enter the harbor during 30-knot winds and 8-foot waves via the South Entrance Channel at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to 3,500 feet south of the NFTA Seaway Pier No. 2.	Iron Ore Limestone Sand and Gravel
IIIg - Rail Transshipment of Iron Ore from NFTA	Deepen the South Entrance Channel to 32 feet. Deepen the Outer Harbor to 28 feet from the end of the Lackawanna Canal to 3,500 feet south of NFTA Seaway Pier No. 2. Remove 750 feet of the South Breakwater. Construction of 1,000 feet of breakwall on the lake side of the South Breakwater. Also add 500 feet of breakwall to the South Entrance arm breakwall. Development of an iron ore rail transshipment facility at NFTA.	Vessels up to and including Class 10 able to enter the harbor during 30-knot winds and 8-foot waves via the South Entrance Channel at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to 3,500 feet south of NFTA Seaway Pier No. 2.	Iron Ore Limestone Sand and Gravel
IIIh - Rail Transshipment of Iron Ore from Independent Cement	Deepen the South Entrance Channel to 32 feet. Deepen the South Outer Harbor to 28 feet from the end of the Lackawanna Canal to 2,000 feet northwest of the south breakwaters northside light. Remove 750 feet of the South Breakwall. Construction of 1,000 feet of breakwall on the lakeside of the south breakwater. South Breakwater. Also add 500 feet of breakwall to the South Entrance arm breakwall. Development of an iron ore rail transshipment facility at Independent Cement.	Vessels up to and including Class 10 able to enter the harbor during 30-knot winds and 8-foot waves via the South Entrance Channel at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to 2,000 feet northwest of the South Break-water north side light.	Iron Ore Limestone Sand and Gravel
IIIi - Shuttle Vessel Transshipment of Iron Ore From Independent Cement	Deepen the South Entrance Channel to 32 feet. Deepen the South Outer Harbor to 28.0 feet from the end of the Lackawanna Canal to 2,000 feet northwest of the south breakwaters northside light. Remove 750 feet of the south breakwall. Construction of 1,000 feet of breakwall on the lakeside of the South Breakwater. Also add 500 feet of breakwall to the South Entance arm breakwall. Development of an iron ore shuttle vessel transshipment facility at Independent Cement.	Vessels up to and including Class 10 able to enter the harbor during 30-knot winds and 8-foot waves via the South Entrance Channel at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to 2,000 feet northwest of the South Break-water north side light.	Iron Ore Limestone Sand and Gravel
IVa - Outer Harbor Deepening	Deepen the South Entrance Channel to 32 feet. Deepen the Outer Harbor to 28 feet from the end of the Lackawanna Canal to 3,500 feet south of NFTA Seaway Pier No. 2. Remove 750 feet of the South Breakwater. Construction of 1,000 feet of breakwall on the lake side of the South Breakwater. Also add 500 feet of breakwall to the South Entrance arm breakwall.	Vessels up to and including Class 10 able to enter the harbor during 30-knot winds and 8-foot waves via the South Entrance Channel at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to 3,500 feet south of the NFTA Seaway Pier No. 2.	Iron Ore Limestone Sand and Gravel
IVb - South Entrance Improvement	Deepen the South Entrance Channel to 32 feet. Deepen the South Outer Harbor to 28 feet from the end of the Lackawanna Canal to 2,000 feet northwest of the South Breakwaters north side light. Remove 750 feet of the south breakwall. Construction of 1,000 feet of breakwall on the lake side of the South Breakwater. Also add 500 feet of breakwall to the South Entrance arm breakwall.	Vessels up to and including Class 10 able to enter the harbor during 30-knot winds and 8-foot waves via the South Entrance Channel at a 25.5 maximum operating draft. A 25.5-foot MOD extends from the end of the Lackawanna Canal to 2,000 feet northwest of the South Break-water's north side light.	Iron Ore Limestone Sand and Gravel

(2) Plan IIe. - This plan services the same upriver areas as Plan IId via the South Entrance. The Outer Harbor MOD is 25.5 feet from the south end of the Lackawanna Canal to 2,000 feet south of Seaway Pier No. 2. Class 10 vessels and below delivering iron ore, limestone, and sand and gravel would be able to service the docks located in the improved areas at a MOD of 25.5 feet. This plan would also affect a portion of the iron ore consumed on the Buffalo River and Union Canal. Presently iron ore vessels servicing these two locations enter the Outer Harbor at operating drafts greater than those permissible on the Buffalo River and Union Canal. Therefore, a portion of each vessels' iron ore cargo is unloaded (lightered) at an Outer Harbor public dock. This lightering operation allows these iron ore vessels to take full advantage of the increased Outer Harbor depths while still permitting direct delivery to their final destination. This plan would also affect the limestone transportation costs of Buffalo River and Union Canal users. Currently, the limestone used in these areas is delivered directly to the plant. It is assumed that in 1990, limestone would be lightered as iron ore is today. Consequently, Plan IIe would allow limestone vessels to take full advantage of the increased Outer Harbor water depths, lighter more tons per trip in the Outer Harbor and reduce total limestone transportation costs under improved project conditions.

(3) Plans IIIf and IIIg - These plans consist of South Entrance Channel improvements, Outer Harbor deepening improvements and the construction of an iron ore transshipment facility at the Niagara Frontier Transportation Authority. Iron ore would be transshipped by either rail or special purpose vessel. Iron ore would be delivered to the Outer Harbor in Class 10 vessels and transshipped via a special purpose vessel (Plan IIIf) or by rail (Plan IIIg) to iron ore users located on the Buffalo River and Union Canal. Vessels servicing Outer Harbor docks located in the improved area and the Lackawanna Canal would have a maximum operating draft of 25.5 feet. These plans would also affect limestone transportation costs for users located on the Buffalo River, Union Canal, and Lackawanna Canal. The Buffalo River and Union Canal users would have lower limestone transportation costs due to increased lightering in the Outer Harbor. Transportation costs of limestone delivered to the Lackawanna Canal would also decrease due to the greater Outer Harbor maximum operating drafts provided by Alternative Plans IIIf and IIIg.

(4) Plans IIIh and IIIi - These plans propose an improved South Entrance Channel and an iron ore transshipment facility located at Independent Cement. Again iron ore destined for the Buffalo River or Union Canal would be delivered to the Outer Harbor in Class 10 vessels and transshipped via rail (IIIh) or special purpose vessel (IIIi). Iron ore and limestone would be delivered to the Lackawanna Canal in Class 10 vessels or below at a MOD of 25.5 feet. These plans would also reduce Bufalo River and Union Canal limestone transportation costs. A limestone lightering operation similar to that occurring in Plans IIIf and IIIg would take place at Independent Cement under these two alternatives.

(5) Plan IVa - This is a South Entrance improvement plan that allows a maximum operating draft of 25.5 feet from the south end of the Lackawanna Canal to the end of Seaway Pier No. 2. This plan would allow iron ore or

limestone to be delivered to the Lackawanna Canal at a 25.5 MOD in Class 10 vessels and below. Iron ore and limestone users on the Buffalo River and Union Canal would have lower transportation costs for these commodities because of the increased lightering activity that could take place at the NFTA facilities. There would be no change in vessel size used to carry the iron ore or limestone. These vessels would however be able to utilize the greater operating draft provided by the proposed improvements. Other docks located within the proposed improvement area could also take advantage of the greater MOD provided in the Outer Harbor.

(6) Plan IVb - This is a South Entrance improvement plan that allows a maximum vessel operating draft of 25.5 feet from the south end of the Lackawanna Canal to 2,000 feet northwest of the South Breakwaters north side light. Class 10 vessels and below would be able to service the Lackawanna Canal at a MOD of 25.5 feet. Lightering of iron ore and limestone destined for the Buffalo River and Union Canal would increase under this alternative, but not as much as in Plan IVa since the 25.5-foot Outer Harbor MOD does not extend all the way to Seaway Pier No. 2. A fuller description of the alternatives is presented in the Main Report.

B2. HISTORICAL ACTIVITY

a. Economic Base.

(1) Introduction - The geographic area affected by the Port of Buffalo is considered to be the eight counties of Western New York (the Western New York Region). The region includes Erie and Niagara Counties (the Buffalo SMSA) plus the following surrrounding counties: Allegheny, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming. The Buffalo SMSA forms the economic core of the region with the six surrounding counties forming the periphery. While the surrounding counties are by no means entirely dependent upon the economy of the SMSA, they are affected by it as a result of commuting and trade patterns and flows of commodities (linkages).

Published statistics on population, employment, personal income, and labor and proprietor's income were examined. Where relevant, available data has been presented to include the Buffalo SMSA (Erie and Niagara Counties), the rest of the Western New York Region (Allegheny, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming Counties) and the Western New York Region (all eight counties listed above). In the case of population, the SMSA data has been further disaggregated into Erie and Niagara Counties with Erie County being subdivided into the city of Buffalo and the rest of Erie County. Disaggregation of Buffalo into Erie and Niagara Counties was possible for personal income. It was not possible to disaggregate Erie County personal income data into smaller units since such data was not available for the city of Buffalo.

(2) Population - Table B2 presents data on population in the Western New York Region and its component areas for each decennial data from 1940 through 1980. Table B3 presents the percent distribution of the regional population across component areas at each decennial date.
The population of the Western New York Region increased from 1,298,000 in 1940 to 1,758,500 in 1970. The annual growth rate for this period was 1.0 percent per year. Between 1970 and 1980, the regional population declined from 1,758,500 to 1,664,000, a decline of 5.4 percent or 0.6 percent per year.

Population growth in the Buffalo SMSA paralleled that of the region, which is to be expected since the SMSA accounted for 73.8 percent of the region's population in 1940 and 74.7 percent in 1980. The Buffalo SMSA's population grew at an annual rate of 1.14 percent from a level of 958,500 in 1940 to 1,349,200 in 1970. Between 1970 and 1980, the population of the Buffalo SMSA declined by 7.9 percent to 1,242,600 (-0.8 percent per year). Within the SMSA, Niagara County's population peaked in 1960 when its 242,300 residents accounted for 14.3 percent of the regional population. Erie County's population peaked ten years later at 1,113,500 in 1970 when it accounted for 63.3 percent of the regional total.

Erie County has been subdivided into the city of Buffalo and the rest of Erie County. The two areas have opposing growth patterns. Buffalo's population peaked in 1950 when it had 580,100 residents and had declined to 357,900 by

Table B2 - Historical Western New York Region (Thousands) Population - (1940 - 1980)

	Year				
	1940	1950	1960	1970	1980
Buffalo SMSA	958.5	1,089.2	1,307.0	1,349.2	1,242.6
Niagara County	160.1	190.0	242.3	235.7	227.1
Erie County	798.4	899.2	1,064.7	1,113.5	1,015.5
City of Buffalo	(575.9)	(580.1)	(532.8)	(462.8)	(357.9)
Rest of Erie County	(222.5)	(319.1)	(531.9)	(650.7)	(657.6)
Rest of Western New York Region	339.5	367.1	392.5	409.3	421.4
Allegheny County	39.7	43.8	44.0	46.5	51.6
Cattaraugus County	72.7	77.9	80.2	81.7	85.5
Chautauqua County	123.6	135.2	145.4	147.3	146.6
Genesee County	44.5	47.6	54.0	58.7	59.4
Orleans County	27.8	29.8	34.2	37.3	38.5
Wyoming County	31.4	32.8	34.8	37.7	39.8
Total Western New York Region	1,298.0	1,456.3	1,699.5	1,758.5	1,664.0

SOURCE: Bureau of the Census, U.S. Department of Commerce, Census of Population for 1940, 1950, 1960, 1970, 1980.

1980. This amounts to a 38.3 percent decline at an average annual rate of minus 1.6 percent. The remainder of Erie County has experienced continued population growth from 1940 (222,500 residents) to 1980 (657,600 residents). Its average annual growth rate has been 2.7 percent. The city's share of the regional population declined from 44.4 percent to 21.5 percent between 1940 and 1980. The rest of Erie County saw its share increase from 17.1 percent to 39.5 percent.

The regional population outside of the Buffalo SMSA, the rest of Western New York, also experienced continued growth from 1940 (339,500 residents) to 1980 (421,400). However, its growth has been quite modest; it grew 24.0 percent for an average annual growth rate of 0.5 percent.

The overall pattern of population growth for the Western New York Region has been positive except for the substantial decline in Buffalo's population.

(3) Employment - There is no current comprehensive employment data for the Western New York Region since data from the 1980 Census of Housing and Population was not available when the report was being prepared. The data available is for the Buffalo Labor area which is synonymous with the Buffalo SMSA - Erie and Niagara Counties. Table B4 presents data on nonagricultural employment by industry. The data covers the period 1951-1980. For the Buffalo SMSA, Table B5 presents the percent distribution of total nonagricultural employment across major industrial groups. The employment data in Table B4 shows that total nonagricultural employment in the Buffalo SMSA has grown during the period 1951-1980. It grew from 434,100 employees in 1951 to 503,360 in 1980. This represents a 15.9 percent growth over 29 years, which produces an average annual growth rate of 0.5 percent per year. This is slightly greater than the average annual rate of population growth (0.45 percent) for the Buffalo SMSA in the 1950-1980 period.

Table B3 - Percent Distribution of Regional Population

	Year				
	1940	1950	1960	1970	1980
Buffalo SMSA	73.8	74.8	76.9	76.7	74.7
Niagara County	12.3	13.0	14.3	13.4	13.6
Erie County	61.5	61.7	62.6	63.3	61.0
City of Buffalo	(44.4)	(39.8)	(31.3)	(26.3)	(21.5)
Rest of Erie County	(17.1)	(21.9)	(31.3)	(37.0)	(39.5)
Rest of Western New York Region	26.2	25.2	23.1	23.3	25.3
Allegheny County	3.1	3.0	2.6	2.6	3.1
Cattaraugus County	5.6	5.3	4.7	4.6	5.1
Chautauqua County	9.5	9.3	8.6	8.4	8.8
Genesee County	3.4	3.3	3.2	3.3	3.6
Orleans County	2.1	2.0	2.0	2.1	2.3
Wyoming County	2.4	2.2	2.0	2.1	2.4
Total Western New York Region	100.0	100.0	100.0	100.0	100.0

SOURCE: Table B2

Table B4 - Buffalo SMSA Nonagricultural Employment
(000's)

	Year 1951	1960	1970	1980	March 1982
Total Nonagricultural	434.1	441.7	496.9	503.3	492.7
Manufacturing	203.6	176.5	168.9	134.4	118.3
Durable Goods	135.5	117.5	113.3	89.3	75.2
Stone, Clay and Glass	9.7	8.9	7.7	6.6	5.4
Primary Metals	42.9	33.6	34.2	18.0	11.3
Fabricated Metals	13.0	14.8	13.3	12.4	11.4
Machinery (i.e., Electrical)	14.5	14.2	13.5	13.1	12.2
Electrical Equipment	14.3	13.8	13.8	12.0	11.0
Transportation Equipment	33.9	26.5	25.7	21.3	18.2
Other Durable Goods	7.2	5.7	5.1	5.9	5.7
Nondurable Goods	68.1	59.1	55.5	45.1	43.1
Food Products	17.5	15.9	12.9	9.1	8.4
Textiles and Apparel	6.1	4.2	3.7	3.5	3.1
Papers and Allied Products	7.7	7.4	6.5	4.0	3.7
Printing and Publishing	7.5	7.7	9.1	9.0	9.1
Chemicals and Allied Products	19.6	16.7	14.2	9.2	9.2
Rubber and Plastic Products	4.8	4.0	5.4	5.4	5.1
Other Nondurable Goods	4.9	3.2	3.7	4.9	4.5
Nonmanufacturing	230.8	265.2	328.0	368.9	356.2
Transportation and Public Utilities	40.2	33.4	32.4	27.3	24.9
Wholesale and Retail Trade	76.1	84.5	102.2	113.6	105.9
Finance, Insurance and Real Estate	13.1	15.8	19.4	22.4	22.3
Services and Mining	44.8	54.9	75.8	100.8	107.1
Government	37.8	50.9	79.2	88.0	84.5
Other Nonmanufacturing	18.8	25.7	19.0	16.8	11.5

SOURCE: Employment and Earnings, State and Areas, 1939-1970. Bureau of Labor Statistics Department of Labor.

Table B5 - Percent Distribution of Total Nonagricultural Employment by Major Industrial Categories

	Year			
	1951	1960	1970	1980
Total Nonagricultural	100.0	100.0	100.0	100.0
Manufacturing	46.9	40.0	34.0	26.7
Durable Goods	31.2	26.5	22.8	17.7
Nondurable Goods	15.7	13.4	11.2	18.0
Nonmanufacturing	53.1	60.0	66.0	73.3
Transportation and Public Utilities	9.3	7.6	6.5	5.4
Wholesale and Retail Trade	17.5	19.1	20.6	22.6
Finance, Insurance, and Real Estate	3.0	3.6	3.9	4.4
Services and Mining	16.3	12.4	15.3	20.0
Government	8.7	11.5	15.9	17.5
Other Nonmanufacturing	4.3	5.8	3.8	3.3

SOURCE: Table B4.

The data on total nonagricultural employment does, however, mask a significant change in the composition of employment in the region between 1951 and 1980. Manufacturing, which has been the traditional basis of the regional economy, declined from 203,600 employees in 1950 to 134,400 in 1980, a decline of 34.0 percent over 29 years. Manufacturing employment as a percent of national nonagricultural employment has decreased from 29 percent in 1950 to 23 percent in 1980. As a result, manufacturing's share of total nonagricultural employment in the SMSA declined from 46.9 percent in 1950 to 26.7 percent in 1980. A decline of this magnitude, a decrease of 69,200 jobs in manufacturing, represents a significant social and economic change. The replacement of lost manufacturing jobs by service and trade positions depresses the level of personal income in the community since service and trade positions pay lower wages and salaries.

Since Buffalo Harbor is characterized as a bulk commodity harbor in that its principal receipts are iron ore and limestone for the iron and steel industry, and grain for the grain milling industry, the employment in these two industries have been examined. Given the level of aggregation presented in the employment data in Table B4, specific conclusions for any individual industrial sector are prevented due to an industry mix effect (i.e, there are other industries included in each group). For grain milling, the appropriate industry in Table B4 is food products. This industry lost 8,400 jobs (48 percent of its 1951 base) between 1951 and 1980. However, the industry appears to have stabilized as food processing lost only 700 jobs between 1980 and March 1982.

The situation is different for primary metals, which lost 24,900 jobs (58.0 percent of its 1951 base) by 1980. Between 1980 and March 1982, primary metals lost 6,700 jobs, a 37.2 percent decline of its 1980 base. Much of this decrease could be a temporary loss that will be replaced at a later date when the economy and primary metals industry recovers from the present recession.

(4) Income - Changes in population and employment are good indicies of economic change but change in personal income is generally considered to be a better indication of the general welfare of the community. Personal income is income received from all sources: wages and saleries, interest on transfer payments from government and business. Personal income, on a per capita basis, is considered to be the best single measure of economic welfare.

Table B6 presents data on total personal income for the Western New York Region and its components (the Buffalo SMSA, the rest of the Western New York Region, and for the individual counties) for 1950, 1959, 1970, and 1980. The data is presented in current dollars and in constant 1972 dollars. The implicit price deflator for personal consumption expenditures has been used to convert current to constant 1972 dollars. In each table, each area's share of the state total has been included. Since an area's share would be the same in current and constant dollars, shares are presented only for the distribution in current dollars.

Table B6 - Western New York Regions and Subregions: Personal Income
(Millions of Dollars)

Total Personal Income	Millions of Current Dollars				Millions of Constant 1972 Dollars			
	1950	1959	1970	1980	1950	1959	1970	1980
Buffalo SMSA	1,927	3,013	5,517	11,780	3,393	4,280	5,964	6,585
Erie County	N/A	2,504	4,594	9,723	N/A	3,557	4,966	5,435
Niagara County	N/A	509	922	2,057	N/A	723	997	1,150
Rest of Region	533	730	1,431	3,253	939	1,037	1,547	1,818
Allegheny County	51	69	143	334	90	98	155	187
Cattaraugus County	105	134	262	604	185	190	283	330
Chautauqua County	216	292	528	1,203	380	415	571	672
Genesee	76	107	227	494	134	152	245	276
Orleans	46	68	142	326	81	97	154	182
Wyoming	39	60	129	292	69	85	139	163
Total Western New York Region	2,460	3,743	6,948	15,033	4,331	5,317	7,511	8,403
New York State	27,747	43,632	85,787	180,497	48,850	61,977	92,743	100,893
Percent of State Total								
Buffalo SMSA	6.9	6.9	6.4	6.5	-	-	-	-
Rest of Region	1.9	1.7	1.7	1.8	-	-	-	-
Western New York Region	8.9	8.6	8.1	8.3	-	-	-	-

SOURCE: Bureau of Economic Analysis, U.S. Department of Commerce, unpublished data, Regional Economic Information System, Bureau of Economic Analysis.

Looking at the data on total personal income, it is observed that every area has experienced economic growth in the period 1950-1980. However, because a time series in current dollars reflects an inflation effect, the amount of real growth is exaggerated. Total personal income in constant 1972 dollars presents a much more accurate measure of economic change over time. These data indicate substantial and uniform real growth of personal income throughout the region. The percent change of constant dollar personal income between 1950 and 1980 for the Western New York Region was 94.0 percent. The average annual growth rate was 2 percent per year for the Region. The Buffalo SMSA had a 94.1 percent change in constant personal income (2.2 percent growth per year) and the Western New York Region had a 93.6 percent change (2.2 percent growth per year) for the similar time period 1950 to 1980.

All three areas (the Western New York Region, the Buffalo SMSA, and the rest of the Western New York Region) have had a slightly lower growth in constant personal income than New York State, 106.6 percent between 1950 and 1980. Thus each areas share of the State's total of personal income was slightly less in 1980 than it was in 1950. Western New York State's share declined from 8.9 to 8.3 percent. The Buffalo SMSA declined from 6.9 percent to 6.5 percent. The rest of the Western New York Region's share declined from 1.9 to 1.8 percent. Throughout the period, however, the Buffalo SMSA dominated the regional economy.

The data on personal income per capita, Table B7, particularly the data on real personal income per capita (constant 1972 dollars) is a good measure of economic welfare. This data show that the economic welfare of the average resident in the three areas grew appreciably in the 1950-1980 period. Real personal income per capita for the Western New York Region increased by 69.7 percent or 1.8 percent per year. The rest of the Western New York Region's real personal income per capita increased by 68.5 percent, 1.7 percent per year. In each case, however, regional growth was less than the State growth. For the period 1950 to 1980, State growth in real personal income per capita was 74.0 percent or 1.9 percent per year. Each area's level of personal income per capita relative to the State's level of personal income per capita has declined between 1950 and 1980 (i.e., the Western New York Region's level of personal income per capita as a percentage of the State's level declined from .90 to .88. The Buffalo SMSA decreased from .95 to .92, and the rest of the Western New York Region declined from .77 to .75).

Computing the change in average annual growth rates over the 1950-1980 period is somewhat misleading as the growth has varied substantially throughout the 30-year period. Table B8 presents data on changes in real personal income per capita by subperiods. Basically, the temporal pattern was:

a. Slow growth from 1950-1959 - New York State had a 12.8 percent change in real personal income per capita with an average annual growth rate of 1.3 percent per year. The Western New York Region had a 5.2 percent change in real personal income with an average annual growth rate of 0.6 percent per year. The Buffalo SMSA had a 5.7 percent increase with an average annual growth rate of 0.4 percent per year. The rest of the Western New York

Region had a 3.9 percent increase in real personal income per capita with an average annual growth rate of 1.3 percent per year.

b. Rapid growth from 1959-1970 - New York State's real personal income per capita increased by 36.2 percent over this time period with an average annual growth rate of 2.9 percent per year. Real personal income per capita for the Western New York Region and the Buffalo SMSA increased by 36.5 and 34.2 percent respectively. This translated into an average annual growth rate of 2.9 and 4.7 percent.

Table B7 - Western New York Regions and Subregions Personal Income Per Capita (Millions of Dollars)

Per Capita Personal Income	Current Dollars 1950	Current Dollars 1959	Current Dollars 1970	Current Dollars 1980	1972 Constant Dollars 1950	1972 Constant Dollars 1959	1972 Constant Dollars 1970	1972 Constant Dollars 1980
Buffalo SMSA	1,769	2,318	4,089	9,480	3,114	3,293	4,421	5,299
Erie County	N/A	2,366	4,126	9,575	N/A	3,361	4,461	5,352
Niagara County	N/A	2,111	3,911	9,057	N/A	2,999	4,228	5,063
Rest of Region	1,452	1,869	4,086	7,706	2,556	2,655	4,417	4,307
Total Western New York Region	1,689	2,202	3,951	9,030	2,974	3,128	4,271	5,048
New York State	1,871	2,615	4,695	10,252	3,294	3,714	5,[illegible]76	5,731
Percent of New York State Level								
Buffalo SMSA	.95	.89	.87	.92	.95	.89	.87	.92
Erie County	N/A	.90	.88	.93	N/A	.90	.88	.93
Niagara County	N/A	.81	.83	.88	N/A	.81	.83	.88
Rest of Region	.77	.71	.87	.75	.77	.71	.87	.75
Total Western New York Region	.90	.84	.84	.88	.90	.84	.84	.88

SOURCE: Table B5

Table B8 - Growth in Real Personal Income Per Capita

	1950-1959	1959-1970	1970-1980	1950-1980
<u>New York State</u>				
Percent Change	12.9	36.2	12.9	74.0
Average Annual Rate	1.3	2.9	1.2	1.9
<u>Western New York Region</u>				
Percent Change	5.2	36.5	18.2	69.7
Average Annual Rate of Change	0.6	2.9	1.7	1.8
<u>Buffalo SMSA</u>				
Percent Change	5.7	34.2	19.9	70.2
Average Annual Rate of Change	0.4	4.7	1.8	1.8
<u>Rest of Western New York Region</u>				
Percent Change	3.9	66.4	-2.5	68.5
Average Annual Rate of Change	1.3	2.9	-0.25	1.7

SOURCE: Table B7.

The rest of the Western New York Region had a 66.4 percent increase in real personal income per capita which translated to a 2.9 percent increase per year.

c. Moderate Growth or Decline from 1970 to 1980 - New York State had a 12.9 percent change in real personal income per capita with an average annual growth rate of 1.2 percent per year. The Western New York Region had an 18.2 percent increase with an average annual growth rate of 1.7 percent per year. The Buffalo SMSA had a 19.9 percent increase in real personal income per capita with an average annual growth rate of 1.8 percent per year. The rest of the Western New York Region had a minus 2.5 percent change in real personal income per capita. This translates into an average annual growth rate of minus 0.25 percent per year.

While personal income data is not available by source of industry, labor, and proprietor's income by industry is available for the Buffalo SMSA. Table B9 presents this data in current and constant 1972 dollars for 1970 and 1980.

Table B9 - Buffalo SMSA: Total Labor, Proprietor's Income Measured by Place of Work by Industry (Millions of Dollars)

	Current Dollar				Constant 1972 Dollars			
	1970	1980	Dollar Change	Percent Change	1970	1980	Dollar Change	Percent Change
Current Dollars								
Farm	25.0	36.2	11.2	44.8	27.0	20.2	-6.8	-25.2
Nonfarm	4,391.3	8,545.5	4,154.2	94.6	4747.2	4776.7	29.5	0.6
Agricultural Services and Others	9.2	17.3	8.1	88.0	9.9	9.7	-0.2	-0.2
Mining	2.8	13.0	10.2	364.3	3.0	7.3	4.3	143.3
Construction	248.5	363.3	114.8	46.2	268.6	203.1	-65.5	-24.4
Manufacturing	1,709.8	3,268.0	1,558.2	91.1	1,848.4	1,826.7	-21.7	-1.2
Transportation and Public Utilities	337.0	639.9	302.9	89.9	364.3	357.7	-6.6	-1.8
Trade	665.4	1,240.7	575.3	86.5	719.4	693.5	-25.9	-3.6
Finance, Insurance and Real Estate	168.0	368.4	200.4	119.3	181.6	205.9	24.3	13.4
Service	558.9	1,350.2	791.3	141.6	604.2	754.7	150.5	24.9
Government	691.7	1,284.7	593.0	85.7	747.8	718.1	-29.7	-4.0
Total Labor and Proprietor's Income	4,416.3	8,581.2	4,165.4	94.3	4,774.2	4,796.9	22.7	0.5

SOURCE: Bureau of Economic Analysis, U.S. Department of Commerce, unpublished data, Regional Economic Information Systems, Bureau of Economic Analysis.

The constant dollar data is most informative as it eliminates the inflationary effect. An examination of Table B9 shows that total labor and proprietor's income, and nonfarm labor and proprietor's income, has virtually remained unchanged in constant 1972 dollars in the Buffalo SMSA between 1970 and 1980. Nonfarm labor and proprietor's income in constant 1972 dollars increased from $4,747,200,000 in 1970 to $4,776,700,000 in 1980. The resulting increase of $29,500,000 represents only a 0.6 percent increase during the decade.

Again change in total nonfarm labor and proprietor's income masks significant changes within the nonfarm sector. The most notable is the large increase in labor and proprietor's income originating in the service and mining sector in which mining is virtually insignificant. This sector's income increased 24.9 percent ($150,500,000) in constant 1972 dollars between 1970 and 1980. Table B4 shows that employment in the service and mining sector increased 33.0 percent. Table B9 shows that labor and proprietor's income originating in the service sector increased by only 24.9 percent in the decade 1970-1980. This substantiates the previously mentioned depressing effect the shift from manufacturing to service employment has had on the local economy. This highlights the fact that the growth of the service sector has been the source of real growth in Buffalo's local economy.

The effect of these shifts in labor and proprietor's income is seen in Table B10 which presents the percent distribution of labor and proprietor's income in 1970 and 1980. Most notable is the expected increase in the service industries share which increased from 12.7 percent to 15.7 percent between 1970 and 1980.

Table B10 - Buffalo SMSA: Percent Distribution of Total Labor and Proprietor's Income Measured by Place of Work by Industry Source

	1970	1980
Farm	.6	.4
Nonfarm	99.4	99.6
Agricultural Services and Others	.2	.2
Mining	.1	.2
Construction	5.6	4.2
Manufacturing	38.7	38.2
Transportation and Public Utilities	7.6	7.5
Trade	15.1	14.5
Finance, Insurance and Real Estate	3.8	4.3
Services	12.7	15.7
Government	15.7	15.0
Total Labor's Proprietor's Income	100.0	100.0

SOURCE: Table B8

Manufacturing's share of labor and proprietor's income has declined only slightly, from 38.7 percent in 1970 to 38.2 percent in 1980. Though there has been a loss of 34,500 jobs in manufacturing in the Buffalo SMSA (a 20.4 percent decline from the 1970 base), there has been a decline in labor and proprietor's income originating in manufacturing of $21,700,000 constant 1972 dollars. It would seem that the manufacturing jobs remaining in 1980 are relatively high wage jobs. Any further decline in the manufacturing base would, therefore, be expected to have a disporportionately negative effect upon the local economy.

b. Commodity Types and Flows.

(1) Overview - The major commodities entering Buffalo Harbor today are: grain (wheat, barley and rye), iron ore, limestone, sand and gravel, gypsum and salt. Table B11 presents the relative importance of these and other selected commodities for 1957, 1962, 1967, and 1971-1980. Total Buffalo Harbor tonnages are also presented for these years. The Buffalo Harbor area consists of the Outer Harbor, Lackawanna Canal, Union Canal, the Buffalo River to the Erie Lackawanna Railroad Bridge and the Buffalo Ship Canal.

Total tonnage accommodated at Buffalo Harbor, NY between 1957 and 1962 decreased by 33 percent from 19,109,136 short tons to 12,775,020 short tons (Table B11). Prior to the completion of the Seaway project the average level of annual waterborne activity was about 16 million tons per year. However, during the period which followed, average annual waterborne tonnage was only 10 million tons per year.

The geographic advantage of a commercial harbor at Buffalo, NY, which is at the most eastern end of Lake Erie, has gradually been eroded. Other man-made improvements such as the Welland Canal and St. Lawrence River Locks created more profitable trade route opportunities for the movement of dry bulk flows to Gulf of St. Lawrence deepwater ports. The impact of these changes upon major commodity groups and sourcing patterns will now be addressed. Table B12 presents the tonnages originating from specific ports from 1976 to 1980 for Buffalo Harbor's six main commodities: grain, iron ore, limestone, sand and gravel, gypsum and salt.

(2) Grain - Many transportation analysts have associated the influx of moderate-sized ocean vessels into the Great Lakes via the Welland Canal as the primary reason why the locational advantage of Buffalo Harbor has diminished. Many of these vessels are capable of transporting grain to foreign markets and effectively bypassing the need for vessels to terminate in Buffalo, NY.

Also, earlier improvements to the inland waterway tributaries of the Mississippi River made barge movements of grain to Gulf Coast ports

Table B11 - Selected Commodity Movements at Buffalo Harbor, NY (Short Tons)

Commodity	Year 1957	1962	1967	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	Average Tonnages 1971-1980	Average Tonnages 1976-1980
Barley and Rye	491,503	101,741	173,303	125,943	231,883	94,394	117,599	99,277	128,509	66,249	92,062	39,484	85,469	108,087	82,355
Wheat	1,901,044	1,663,695	1,314,004	1,267,830	1,235,699	1,225,057	1,062,926	1,304,799	1,430,648	1,310,195	1,399,439	1,223,691	1,360,900	1,282,118	1,344,975
Iron Ore	8,521,807	5,416,266	8,754,443	5,699,897	4,213,406	7,688,560	5,337,365	3,142,567	7,022,794	3,968,416	4,512,112	4,865,371	2,598,322	4,904,881	4,593,403
Limestone	3,613,845	2,086,210	2,284,772	1,246,882	1,120,168	2,041,886	1,778,219	1,315,954	1,660,727	1,202,097	1,326,758	947,726	478,246	1,311,866	1,123,111
Sand, Gravel, Crushed Rock	831,139	220,275	278,855	365,554	304,214	444,129	325,857	204,506	288,692	324,160	292,028	314,473	206,240	306,985	285,119
Gypsum, Crude, Plasters	0	0	0	10,490	0	0	21,605	122,157	120,227	167,909	205,527	178,148	65,278	89,134	147,418
Nonmetallic Minerals	27,137	51,088	141,746	171,323	281,003	121,536	159,376	151,379	97,269	250,248	182,364	87,783	80,599	158,288	139,653
Residual Fuel Oil	351,604	219,715	117,098	185,328	199,850	253,736	233,456	141,342	183,323	171,865	301,534	257,281	116,600	204,432	206,121
Building Cement	34,776	126,576	192,998	272,620	198,133	167,133	246,404	202,492	148,191	191,994	247,888	166,137	252,480	209,347	201,338
Pig Iron	597,513	206,442	160,319	128,549	113,023	55,085	20,334	70,268	79,440	65,461	63,288	0	14,474	60,992	44,533
Coke Petroleum, Asphalt	0	0	0	86,972	53,800	247,490	75,700	67,906	190,790	62,000	0	0	0	78,466	50,558
Selected Commodity Tonnage Subtotal	16,370,368	10,092,008	13,417,541	9,561,388	7,951,179	12,339,006	9,378,841	6,822,647	11,350,610	7,780,594	8,623,000	8,080,094	5,258,608	8,714,596	8,218,584
Total Harbor Tonnage	19,109,136	12,775,020	14,442,117	10,137,206	8,448,185	12,603,820	9,576,553	7,018,748	11,481,716	7,975,244	9,134,753	8,315,880	5,470,309	9,016,241	8,475,580
Selected Commodities as a Percentage of Total Harbor Tonnages	86	79	93	94	94	98	98	97	99	98	94	97	96	97	97

SOURCE: Unpublished Waterborne Commerce Statistics of the United States, Annual Port to Port Summary - 1971-1980.

increasingly competitive vis-a-vis Great Lakes bulker movements. Both of these institutional changes eroded the competitive position of the grain industry during the last 25 years. This decline in grain traffic can be seen in Table B11 where grain receipts totalled 2,392,547 tons in 1957 and 1,446,369 in 1980.

Table B12 indicates that grain receipts during the period 1976-1980 have averaged about 1,427,000 tons and have consistently originated from the harbors of Duluth, Minnesota, and Superior, Wisconsin. Grain for this time period comprised approximately 18 percent of the total harbor tonnage. Almost all of the annual grain activity consists of domestic receipts with only very minor amounts of grain originating from several Canadian harbors. Presently, 85 percent of the grain is destined for elevators located approximately 2.5 miles up the Buffalo River. The balance is destined for a grain elevator located on the Buffalo Ship Canal.

(3) Iron Ore - Between 1976 and 1980, iron ore comprised 53 percent of the total tonnage. Although its relative share of total tonnage has remained comparatively constant, annual volumes have dropped substantially. Buffalo Harbor iron ore receipts fell from 7,022,794 short tons in 1976 to 2,598,322 short tons in 1980.

Iron ore delivered to the Buffalo Harbor is destined for two Outer Harbor companies and an iron ore user located approximately 5 miles up the Buffalo River. All of the iron ore is used by these companies to produce pig iron. This pig iron is then used by two local steel companies to produce steel. The third company sells the majority of its pig iron to a local company which makes pig iron ingot molds for a Detroit based steel company and the balance is sold to foundries to make cast iron products.

Upriver iron ore receipts prior to 1979 were obtained mainly from Canadian Gulf of St. Lawrence ports and averaged about 750,000 tons per year. However, with the completion of a modern iron ore transshipment facility at Lorain Harbor, OH, the upriver steel company now sources its raw materials from U.S. harbors located in the upper lakes. This material is currently delivered to Lorain Harbor in maximum size 1,000-foot X 105-foot vessels and reloaded into smaller Class 5 self- unloading vessels for delivery to the upriver steel plant in Buffalo, NY. It is expected that this sourcing pattern will continue in the future.

Currently a portion of the iron ore destined for upriver usage and the Union Canal is discharged at a public dock facility in the Outer Harbor. This procedure allows the iron ore shippers to take full advantage of the operating draft available in the Outer Harbor. Ore vessels can enter Buffalo Harbor at a maximum operating draft greater than the Buffalo River or Union Canal, "lighter" the number of tons needed to bring the vessel to a safe operating draft on the Buffalo River or Union Canal and deliver the remaining tons directly to the docks. The lightered tonnage is then trucked to stockpiles along the Buffalo River and Union Canal as required. This lightering operation is expected to continue in the future.

Table B12 - Historical Traffic Summary - Buffalo Harbor

Commodity	Origin	1976	1977	1978	1979	1980
Grain						
	Superior, WS	727,497	716,429	650,633	514,802	561,943
	Duluth, MN	783,917	618,072	811,021	734,640	840,293
	Other	47,743	41,943	29,847	13,733	44,178
Total		1,559,157	1,376,444	1,491,501	1,263,175	1,446,414
Iron Ore						
Upriver Domestic						
	Superior, WS	-	-	-	69,432	12,292
	Duluth, MN	2,800	-	-	-	624,912
	Escanaba, MI	12,613	-	-	-	-
	Taconite, MN	-	-	-	-	123,367
	Silver Bay, MN	-	-	195,360	-	-
	Subtotal	15,413	0	195,360	69,432	760,571
Upriver Foreign						
	Sept. Isles, Que.	838,707	614,419	601,968	717,924	-
	Contrecoeur, Que.	103,660	101,198	25,082	-	-
	Montreal, Que.	-	7,228	-	-	-
	Subtotal	942,367	722,845	627,050	717,924	0
Subtotal River		957,780	722,845	822,410	787,356	760,571
Iron Ore						
Lakefront Domestic						
	Superior, WS	137,333	127,115	117,444	500,703	1,171,151
	Duluth, MN	485,866	303,568	135,286	78,697	14,661
	Taconite, MN	1,710,085	699,342	2,382,250	2,581,741	88,332
	Silver Bay, MN	593,609	151,635	-	-	-
	Escanaba, MI	550,189	-	-	-	-
	Presque Isle, MI	25,245	-	-	-	-
	Two Harbors, MN	85,090	-	-	-	-
	Subtotal	3,586,417	1,345,862	2,719,455	3,366,212	1,274,144
Lakefront Foreign						
	Pt. Noir, Que.	319,249	-	-	-	-
	Sept. Isles, Que.	1,430,870	1,342,478	448,119	492,383	563,607
	Picton, Ont.	457,660	206,688	-	-	-
	Contrecoeur, Que.	25,360	-	127,079	-	-
	Depot Harbor, Ont.	72,313	342,888	301,413	155,444	-
	Other	173,145	7,655	93,636	63,976	-
	Subtotal	2,478,597	1,899,709	907,247	711,803	563,607
Subtotal Lakefront		6,065,014	3,245,571	3,689,702	4,078,015	1,837,751
Total		7,022,794	3,968,416	4,512,112	4,865,371	2,598,322

Table B12 - Historical Traffic Summary - Buffalo Harbor (Cont'd)

Commodity	Origin	1976	1977	1978	1979	1980
Limestone						
Upriver Domestic						
	Stoneport, MI	150,848	101,900	124,761	83,383	73,231
	Calcite, MI	140,963	121,830	143,778	-	-
	Port Dolomite, MI	13,307	24,522	26,559	-	-
Subtotal River		305,118	248,252	295,098	83,383	73,231
Lakefront Domestic						
	Stoneport, MI	606,056	485,906	558,963	414,079	200,340
	Calcite, MI	118,361	89,863	-	19,455	13,300
	Port Dolomite, MI	39,700	49,872	110,642	102,307	-
	Drummond Is, MI	591,492	328,204	362,055	328,512	191,375
Subtotal Lakefront		1,355,609	953,845	1,031,660	864,343	405,015
Total		1,660,727	1,202,097	1,326,758	947,726	478,246
Sand & Gravel						
Ship Canal						
	Ludington, MI	174,718	206,526	197,332	213,778	125,353
	Ferrysburg, MI	-	-	44,666	-	-
Subtotal Ship Canal		174,718	206,526	241,998	213,778	125,353
Lakefront	Ferrysburg, MI	113,974	117,634	50,030	100,695	53,315
	Grand Haven, MI	-	-	-	-	27,572
Subtotal Lakefront		113,974	117,634	50,030	100,695	80,887
Total		288,692	324,160	292,028	314,473	206,240
Gypsum						
Lakefront Domestic	Port Gypsum, MI	120,227	167,909	205,527	178,148	65,278
Salt						
Lakefront Domestic						
	Cleveland, OH	-	36,673	23,800	10,969	13,097
	Fairport, OH	83,822	94,989	83,250	44,789	45,610
Domestic Subtotal		83,822	131,662	107,050	55,758	58,707
Lakefront Canadian						
	Montreal/Gulf of St. Lawrence		42,058	13,601	-	-
	Upper Lakes	-	60,009	51,078	-	21,874
Canadian Subtotal		-	102,067	64,679	-	21,874
Total		83,822	233,729	171,729	55,758	80,581

Lakefront iron ore has been acquired from domestic upper lakes harbors and Canadian lower lakes ports. During the period 1976-1980, domestic iron ore constituted approximately 65 percent of the total Outer Harbor iron ore. Duluth/Superior and Taconite Harbors supplied 88 percent of the domestic Outer Harbor iron ore during this 5-year period. The most prominent Canadian source harbor for Outer Harbor iron ore has been Sept. Isles, Quebec. The annual foreign volumes as a percentage of total Outer Harbor iron ore have been declining in recent years. In 1976, foreign iron ore comprised 41 percent of total Outer Harbor ore and in 1980, 31 percent. This decrease is most likely related to the sustained downturn in the U.S. steel industry and the shift in supply patterns towards upper lakes harbors.

(4) Limestone - Limestone receipts constitute the third largest commodity tonnage movement in the harbor. The amount of limestone received at Buffalo Harbor is directly related to the production of pig iron and final steel products. Over 92 percent of all limestone delivered to Buffalo Harbor between 1976 and 1980 was used as a flux in local blast and open hearth furnaces. The limestone helps remove impurities from such molten metals as pig iron and steel. Table B12 indicates all of the limestone has been sourced from harbors along Lake Huron. The decline in total limestone receipts to the Buffalo Harbor has paralleled the decline in iron ore receipts. Limestone receipts fell from 1,660,727 short tons in 1976 to 478,246 short tons in 1980.

Since 1979 all of the upstream limestone has originated from Stoneport, MI and has been destined for the upriver steel plant. The major sources of Lakefront limestone has been Stoneport and Drummond Island, MI. These two origins accounted for 89 percent of the Outer Harbor limestone receipts during the 5-year period 1976-1980.

(5) Sand and Gravel - Buffalo Harbor sand and gravel destination docks are located adjacent to the Buffalo Ship Canal and at the lakefront. The ship canal has received about 200,000 tons of limestone annually from harbors on the east side of Lake Michigan (Table B12). Ludington, MI has been the sole source of ship canal sand and gravel for 4 of the 5 years between 1976 and 1980. In 1978 Ludington accounted for 81 percent of the ship canal's sand and gravel.

Annual sand and gravel volumes received at the Lakefront have been declining in recent years. Volumes fell from 113,974 short tons in 1976 to 80,887 short tons in 1980. Ferrysburg, MI accounted for 93 percent of all Outer Harbor sand and gravel received between 1976 and 1980.

(6) Gypsum - Gypsum has been unloaded at the Niagara Frontier Transportation Authority Docks for transfer to a manufacturing facility located about 20 miles inland. This plant was recently shut down as a result of declining market demand and relative cost of operations.

(7) Salt - Salt receipts have fluctuated between 83,000 and 233,000 tons in the last few years. This material is used primarily for highway ice-control by municipal agencies. The large increase in 1977 reflects the

unique weather conditions which occurred in Buffalo, NY during the "Blizzard of 1977" and the consequent depletion of local salt stockpiles.

Table B12 indicates that domestic origins accounted for 50 to 100 percent of the salt destined for Buffalo between 1976 and 1980. Fairport, OH has characteristically provided at least 50 percent of total salt receipts from 1976 to 1980.

c. Affected Harbor Commerce and Their Origin Ports.

The decrease in transportation costs between the "without project" and "with project" condition forms the basis for navigation benefits attributable to any harbor improvement plan. Only commodities affected would be used in determining navigation benefits for any of these eight alternatives. These commodities are outlined in Table B1 by alternative.

A commodity was categorized as affected if a change in the method of shipment would occur in the future. A change in the method of shipping is defined as a change in maximum operating draft or vessel size between the "without" and "with project" condition. A commodity was defined as not affected if the origin port did not have channel depths at least equal to the depths available at Buffalo.

Major source harbors for the four affected commodities of grain, iron ore, limestone and sand and gravel are presented in Table B13. These origins will be used in determining transportation costs per ton in Section B4 under the "without" and "with project" conditions.

Table B13 - Trade Routes by Commodity

Commodity/Alternative	Origin
Grain	Duluth, MN
Iron Ore	
Domestic	
Outer Harbor	Superior, WS, Taconite, MN, Duluth, MN
Buffalo River	Lorain, OH, Superior, WS, Taconite, MN
Foreign	
Outer Harbor	Sept Isles, Quebec
Limestone	
Outer Harbor	Stoneport, MI, Drummond Is., MI, Dolomite, MI
Buffalo River	Stoneport, MI
Sand and Gravel	
Outer Harbor	Ferrysburg, MI, Grand Haven, MI
Buffalo Ship Canal	Ludington Harbor, MI

d. Historical Fleet Composition.

(1) Overview - Historical fleet characteristics by commodity have been evaluated for the period 1976-1980. Several commodities have shown trends toward concentration into larger ship sizes, while a few commodities have had no change in the relative size or type of vessel used to transport their annual volumes. An overview of the trends in fleet composition is presented in Table B14 and is discussed below.

(2) Grain - Grain receipts since 1978 have been transported in Class 5 vessels exclusively. This concentration has been due to the physical restrictions on vessel size that the present configuration of the Buffalo River imposes.

(3) Iron Ore - A similar concentration in vessel size was also exhibited for upriver iron ore. The physical restrictions of the Buffalo River preclude the operation of vessels larger than 639 feet in length (i.e., Class 5).

The Lakefront iron ore fleet is summarized in Table B14. Union Canal domestic iron ore has been shipped in class 5 vessels exclusively since 1976. This reflects the shallow depth and channel width restrictions present on the Union Canal. In 1980 more than 80 percent of the domestic iron ore destined for the Lackawanna Canal was shipped in Class 10 vessels. This reflects the fact that the company for which the iron ore is destined has a captive Great Lakes fleet which includes several Class 10 (1,000 X 105-foot) self-unloading vessels. A Class 8 vessel is the next most frequently used domestic vessel size at the Lackawanna Canal. This vessel size accounted for almost 29 percent of all tons received at the Lackawanna Canal during the five year period 1976-1980, and is also part of the companies' captive fleet.

Union Canal Canadian iron ore has consistently been transported in Class 7 and Class 4 vessels with the bulk of the tonnage carried by Class 4 vessels. This again reflects the channel width and depth restrictions that the Union Canal imposes. Most of the Canadian iron ore destined for the Lackawanna Canal during 1976-1980 has been transported in Class 7 vessels. Smaller vessels have been used to a limited extent. All of the Canadian iron ore is sourced from below the Welland Canal. The use of Class 7 vessels to carry foreign iron ore maximizes the vessel size that can transit the Welland. This usage is expected to continue in the future.

(4) Limestone - Upriver limestone is limited to vessel dimensions imposed by the Buffalo River. In 1980, 100 percent of the limestone was delivered in class 5 vessels.

Limestone delivered to the Union Canal has increasingly used Class 5 vessels. This vessel size seems to be the most efficient for this location. It is expected that Class 5 vessels will continue to carry all of the limestone destined for the Union Canal in the future.

Class 6 vessels have carried an increasing percentage of limestone destined for the Lackawanna Canal. Again the company for which this limestone is

Table B14 - Distribution of Annual Tonnage, by Commodity, by Vessel Size

Commodity	Vessel Class	1976	1977	1978	1979	1980
		(Percent)	(Percent)	(Percent)	(Percent)	(Percent)
Grain						
Ship Canal	3	30.5	13.8	-	-	-
	4	3.8	19.8	-	-	-
	5	65.7	66.4	100	100	100
Upriver	3	13.7	7.8	-	-	-
	4	0.8	1.0	-	-	-
	5	85.5	91.2	100	100	100
Iron Ore						
Buffalo River Domestic	5	100	-	100	100	100
Buffalo River Canadian	3	9.0	8.0	7.0	-	-
	4	20.0	28.0	23.0	18.0	-
	5	71.0	64.0	70.0	82.0	-
Union Canal Domestic	5	100	100	100	100	100
Union Canal Foreign	4	100	48.0	78.0	87.0	-
	5	-	45.0	22.0	-	-
	7	-	7.0	-	13.0	-
Lackawanna Canal Domestic	5	6.7	11.5	-	-	-
	6	43.9	20.4	20.8	31.3	7.5
	7	12.7	27.8	5.9	-	2.8
	8	36.7	40.3	38.3	28.7	-
	10	-	35.0	35.0	36.5	89.7
Lackawanna Canal Foreign	4	1.0	4.(	-	6.0	-
	5	19.0	11.(	13.0	3.0	-
	6	11.0	14.(	-	7.0	-
	7	66.0	71.(	87.0	84.0	100
	8	3.0	-	-	-	-
Limestone						
Buffalo River Domestic	3	-	4.(	-	-	-
	4	15.8	-	-	40.6	-
	5	84.2	96.(	100	59.4	100

Table B14 - Distribution of Annual Tonnage, by Commodity, by Vessel Size (Cont'd)

Commodity	Vessel Class	1976	1977	1978	1979	1980
		(Percent)	(Percent)	(Percent)	(Percent)	(Percent)
Union Canal						
Domestic	3	-	-	19.6	-	-
	4	80.8	90.5	29.0	-	-
	5	19.2	9.5	51.4	100	-
Lackawanna Canal						
Domestic	4	.8	-	-	-	-
	5	74.7	37.3	41.6	100	-
	6	22.4	62.7	58.4	-	100
	7	2.1	-	-	-	-
<u>Sand & Gravel</u>						
Ship Canal	3	4.2	10.0	-	-	-
	4	5.1	7.0	-	4.9	-
	5	69.4	55.4	71.0	95.1	100
	6	21.4	27.6	29.0	-	-
Lakefront	6	-	-	-	48.9	-
	7	100	100	-	51.1	100
<u>Gypsum</u>	3	19.9	6.0	-	8.0	-
	4	9.5	13.0	-	-	-
	5	70.6	81.0	100	92.0	75.0
	6	-	-	-	-	25.0
<u>Salt</u>						
Lakefront/Domestic	4	-	8.5	-	-	22.3
	5	100	99.5	100	100	77.7
Lakefront/Canadian	3	-	9.7	48.3	-	37.1
	4	-	90.3	51.7	-	62.9

SOURCE: Unpublished Waterborne Commerce Statistics, 1976-1980, Corps of Engineers.

destined has a captive fleet which include two Class 6 vessels. Therefore the use of Class 6 vessels to carry limestone in the future is assumed to continue.

(5) Sand and Gravel - Sand and gravel receipts in the Buffalo Ship Canal have relied upon Class 5 vessels, although several larger ships were used in earlier years to move the required raw materials. Lakefront receipts of sand and gravel, although minor in annual volume, have used Class 7 (i.e., Seaway-size) bulk carriers.

(6) Gypsum - Gypsum receipts at the Lakefront have been shipped in Class 5 self-unloading bulk carriers. Although smaller vessel sizes have also been used, most of the annual volume has been shipped in Class 5 vessel sizes.

(7) Salt - Salt receipts at the Lakefront have also have been concentrated in Class 5 vessels. This is the result of physical constraints at the origin harbor rather than the availability of larger sized bulk vessels to carry the salt.

e. "Without" and "With Project" Project Fleet Composition.

(1) Fleet Composition Constraints - The future fleet composition of Buffalo Harbor is based upon past trends in vessel sizes used at Buffalo (Table B14), interviews with harbor users, the current Great Lakes Fleet, and new vessel construction trends.

Existing Buffalo Harbor channel dimensions (i.e., width and depth) physically restrict the maximum size and operating drafts of vessels in the Outer Harbor, Buffalo River and Buffalo Ship Canal. Many vessels presently entering the harbor area are unable to fully utilize their designed drafts due to draft restrictions in the connecting channels of the harbor.

This planning study is directed towards remedial channel or breakwater modifications at Buffalo Harbor only. External constraints such as the maximum prevailing safe operating draft of 25.5 feet at LWD will be acknowledged but are outside the present study authority. Lock sizes at the Soo, Welland and St. Lawrence River and the physical capacity of the existing locks may restrict future commodity flows into Buffalo and have been explicitly considered in the analysis. None of these constraints which restrict vessel size to 1,000 feet X 105 feet in the upper lakes would be alleviated by Buffalo Harbor modifications.

Currently, 1,000-foot vessels use the South Entrance Channel and the Outer Harbor to maneuver into the privately maintained Lackawanna and Union Canals. Although the existing configuration of breakwaters is adequate for navigation during ideal weather conditions, shipping officials have indicated that changes to the breakwaters are required primarily to provide for safe all-weather operations.

The Inner Harbor consists of the Buffalo River and the Buffalo Ship Canal. The width of the Buffalo River varies from 100 feet to 700 feet. Sharp

channel bends limit vessel lengths to 640 feet and preclude sustained two-way traffic. Under current design standards, the existing 22-foot project depth in the Buffalo River forces most vessels serving this area to either lighter a portion of their cargo at the lakefront or depart from their origin harbor at operating drafts compatible with the maximum draft allowable in the Buffalo Harbor. This assumption is presented in greater detail in Section B4a(4). This in turn, results in higher transportation costs, particularly for upstream bound ore carriers.

The navigable width of the Buffalo River and Ship Canal is restricted by numerous bridges. The Michigan Avenue Bridge abutments previously encroached into the Buffalo Ship Canal and are being removed. In 1964, the original bridge superstructure was removed but the substructure consisting of three concrete and masonry structures (i.e., the east and west abutments and the east pier) remained. The distance between the east and west abutments was 73.5 feet. Vessels entering the Ship Canal were restricted to beams of 60 feet. However, even with the removal of the abutments there is no anticipated increase in the composition of the existing Ship Canal fleet.

Increasing Buffalo Harbor channel depths within the present Federal project limits may allow marginal economies of scale to be realized by the existing fleet. Two iron ore users have maximized their utilization of available channel depths by entering the Lakefront Harbor via the South Entrance Channel and offloading (i.e., lightering) a portion of their iron ore cargos before proceeding to their destination docks located on the Buffalo River and the Union Canal. The public port authority (NFTA) property has been the location where this activity has taken place.

Finally, existing channel widths in the South Entrance Channel present a problem for vessel operator/owners during adverse weather conditions. It has been determined that because of wind, wave action and currents from Lake Erie, additional protection would be needed and could be provided by breakwater modifications to assure greater vessel stability. Further, to allow for more flexible maneuvering, the South Entrance Breakwater parallel to the shore of the Outer Harbor should be shortened from its southernmost point. These measures would help prevent potentially severe structural damages to ships and breakwaters in storm conditions and provide a more efficient configuration under normal weather conditions.

(2) Without Project Fleet Composition - The "Without Project" fleet compostion is based upon continuing the vessel usage patterns outlined previously, especially those vessels used in 1980. Vessel usage patterns are related to geographical areas of the Buffalo Harbor by commodity type for the 50 year evaluation period. Table B15 presents the "Without Project" fleet percent distribution of annual tons moved by vessel class applicable to the eight alternatives being evaluated.

The channel width of the Buffalo River precludes the use of any vessel longer than 639 feet (Class 5). This vessel restriction was highlighted by the exclusive use of Class 5 vessels in 1980 to deliver grain, iron ore, limestone and sand and gravel to docks on the Buffalo River and Ship Canal. Class 5 vessels are assumed to be used to deliver bulk commodities to these docks over the fifty year planning period since there are presently no plans to widen the Buffalo River or Ship Canal channels.

Table B15 - Percent Distribution of Annual Tons Moved by Vessel Class - Without Project Condition

Commodity/	Vessel	Percent of Yearly Tons Moved by Vessel Class						
Geographic Area	Class	1990	1995	2000	2010	2020	2030	2040
Grain-Alternatives IId, IIe								
Domestic	5	100	100	100	100	100	100	100
Iron Ore-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Buffalo River								
Domestic	5	100	100	100	100	100	100	100
Union Canal								
Domestic	5	100	100	100	100	100	100	100
Foreign	7	13	13	13	13	13	13	13
	4	87	87	87	87	87	87	87
Lackawanna Canal								
Domestic	10	90	90	90	90	90	90	90
	8	10	10	10	10	10	10	10
Foreign	7	100	100	100	100	100	100	100
Limestone-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Buffalo River								
Domestic	5	100	100	100	100	100	100	100
Union Canal								
Domestic	5	100	100	100	100	100	100	100
Lackawanna Canal								
Domestic	6	100	100	100	100	100	100	100
Sand and Gravel Lakefront-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Domestic	7	100	100	100	100	100	100	100
Ship Canal-Alternatives IId, IIe								
Domestic	5	100	100	100	100	100	100	100

Outer Harbor iron ore will continue to be delivered in a wide range of vessels from Class 10 to Class 5. Union Canal domestic iron ore shipments are expected to continue to use Class 5 vessels mainly because of the channel maximum operating depth limitation. The Union Canal is presently maintained at 21 feet.

Subtracting a safety factor clearance of 2.5 feet from the channels current maintained depth of 21 feet leaves a maximum operating draft of 18.5 feet on the Union Canal. The pattern of using Class 4 and Class 7 foreign vessels to deliver foreign iron ore is expected to continue in the future for the same reason.

The use of a Class 10 vessel to deliver 90 percent of Lackawanna Canal's domestic iron ore is expected to continue in the future, since this vessel is part of a captive fleet, owned by the Steel Company located adjacent to the Lackawanna Canal. The oher 10 percent of Lackawanna Canal's iron ore will be moved in a Class 8 vessel since this steel company also owns this vessel. The use of all of Lackawanna Canal's foreign tonnage will be transported in Class 7 vessels during the 50-year evaluation period. This vessel size maximizes the trip capacity that can transit the Welland Canal.

Limestone movements to the Union Canal during the 50-year planning period is expected to follow the historical pattern of using Class 5 vessels. The annual tonnage levels of limestone destined for this area does not warrant a vessel size larger than this. Again limestone movements to the Lackawanna Canal are assumed to take place in Class 6 vessels that are part of a captive fleet owned by the Steel Company located adjacent to the Lackawanna Canal.

Finally Lakefront sand and gravel is assumed to move in Class 7 vessels which have historically transported 100 percent of Lakefront sand and gravel.

3. With Project Fleet Composition.

Table B16 presents the "With Project" fleet composition for the various alternatives. The fleet composition remains the same as the "Without Project" fleet composition for all non transshipment alternatives. all non transshipment alternatives provide a deeper maximum operating draft for the without project fleet. These alternatives have no induced vessel size changes associated with them.

Any transshipment Alternative IIIf, IIIg, IIIh, IIIi, has an affect on the vessel fleet used to carry iron ore to users located on the Buffalo River and Union Canal. Under any transshipment alternative all of the iron ore (Domestic and Canadian) destined for the Buffalo River or Union Canal is assumed to use the transshipment facility. It is also assumed that a Class 10 vessel is used exclusively to source the iron ore needed by the two facilities. The use of Class 10 vessels to source the majority of the iron ore destined for the Lackawanna Canal indicates that the use of Class 10 vessels at Buffalo Harbor is economically justified. The transshipment alternatives will provide a deeper operating draft than is presently available in the Outer Harbor and also provide safer entry conditions via the

Table B16 - Percent Distribution of Annual Tons Moved by Vessel Class - With Project Condition

Commodity/ Geographic Area	Vessel Class	1990	1995	2000	2010	2020	2030	2040
Grain-Alternatives IId, IIe								
Buffalo Harbor								
Domestic	5	100	100	100	100	100	100	100
Iron Ore								
Buffalo River-Alternatives IIe, IVa, IVb								
Domestic	5	100	100	100	100	100	100	100
Buffalo River-Alternatives IIIf, IIIg, IIIh, IIIi								
Domestic	10	100	100	100	100	100	100	100
Union Canal-Alternatives IIe, IVa, IVb								
Domestic	5	100	100	100	100	100	100	100
Foreign	7	13	13	13	13	13	13	13
	4	87	87	87	87	87	87	87
Union Canal-Alternatives IIIf, IIIg, IIIh, IIIi								
Domestic	10	100	100	100	100	100	100	100
Lackawanna Canal-Alternatives IIe, IIIf, IIIg, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Domestic	10	90	90	90	90	90	90	90
	8	10	10	10	10	10	10	10
Foreign	7	100	100	100	100	100	100	100
Limestone-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Buffalo River								
Domestic	5	100	100	100	100	100	100	100
Union Canal								
Domestic	5	100	100	100	100	100	100	100
Lackawanna Canal								
Domestic	6	100	100	100	100	100	100	100
Sand and Gravel Lakefront-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Domestic	7	100	100	100	100	100	100	100
Ship Canal-Alternatives IId, IIe								
Domestic	5	100	100	100	100	100	100	100

South Entrance. The long distance sourcing pattern of iron ore destined for the Buffalo River or Union Canal favors the use of larger sized vessels. This shift to Class 10 vessels is assumed to occur in 1990 since the annual level of iron ore tons demanded by these two companies in 2040 could be delivered by one Class 10 vessel. There are presently thirteen Class 10 vessels in the U. S. Fleet, three of which were delivered in 1981 (Table B17). Since there are a limited number of ports that Class 10 vessels can service, any harbor modification that would improve the safe operation of Class 10 vessels at Buffalo Harbor would induce the use of these vessels to deliver iron ore to Buffalo's transshipment facility.

The delivery of all other bulk commodities affected by the transshipment alternatives is assumed to take place in the same vessels that delivered the commodities in the "without project" condition but at a greater maximum operating draft.

Table B17 - New Vessel Construction - U.S. Great Lakes Fleet

Vessel Name	Length (feet)	Type	Year Built
BLOUGH, ROGER	858.0	Self Unloader	1972
CORT, STEWART J.	1,000.0	Self Unloader	1972
KYES, ROGER M.	680.0	Self Unloader	1973
MESABI, MINER	1,004.0	Self Unloader	1973
PRESQUE ISLE	1,000.0	Self Unloader	1973
ROESCH, WILLIAM R.	630.0	Self Unloader	1973
THAYER, PAUL	630.0	Self Unloader	1973
WILSON, CHARLES E.	680.0	Self Unloader	1973
WHITE, H. LEE	704.0	Self Unloader	1974
WOLVERINE	630.0	Self Unloader	1974
LAUD, SAM	634.8	Self Unloader	1975
BARKER, JAMES R.	1,004.0	Self Unloader	1976
BLOCK, JOSEPH L.	728.0	Self Unloader	1976
ST. CLAIR	770.0	Self Unloader	1976
BELLE RIVER	1,000.0	Self Unloader	1977
FOY, LEWIS WILSON	1,000.0	Self Unloader	1978
STINSON, GEORGE A.	1,004.0	Self Unloader	1978
GOTT, EDWIN H.	1,004.0	Self Unloader	1979
WHITE, FRED R. JR.,	636.0	Self Unloader	1979
AMERICAN MARINER	730.0	Self Unloader	1980
BURNS HARBOR	1,000.0	Self Unloader	1980
SPEER, EDGAR B.	1,004.0	Self Unloader	1980
AMERICAN REPUBLIC	634.9	Self Unloader	1981
COLUMBIA STAR	1,000.0	Self Unloader	1981
DELANCEY, WILLIAM J.	1,013.6	Self Unloader	1981
INDIANA HARBOR	1,000.0	Self Unloader	1981

SOURCE: Greenwoods Guide to Great Lakes Shipping, 1972 - 1981

B3. WATERBORNE COMMERCE PROJECTIONS

a. Overview.

Traffic projections are necessary to conduct the economic evaluation of proposed harbor improvements. For purposes of the National Economic Development (NED) Analysis, the project evaluation period is based on the lesser of (a) the period of time over which the project would serve a useful purpose; or (b) the period of time after which further discounting of beneficial and adverse effects would have no appreciable impact. Traditionally the evaluation period has been 50 years for general navigation features.

Waterborne commerce projections were made only for the commodities affected by the eight alternatives outlined in Table B1. Surveys of harbor users, port officials and shippers, as well as historical traffic patterns and a wide range of secondary data formed the basis for the commodity projections. Table B18 contains the commodity projections used to evaluate each of the eight alternatives. The procedures used to construct individual commodity forecasts will now be discussed.

b. Grain.

Several regional studies were examined to determine the relative magnitude of grain movements expected on the Great Lakes in general and at Buffalo Harbor in particular. Among the studies reviewed were the National Waterways Study, Final Report, Traffic Forecasting Methodology, (by A. T. Kearney, August 1981); The National Waterways Study, Evaluation of the Present Waterways System (by A. T. Kearney for the U.S. Army Corps of Engineers Institute for Water Resources, March 1981; and The Great Lakes Saint Lawrence Regional Transportation Studies, Commodity Flow Forecasts, (by Booz-Allen and Hamilton Inc., September 1981).

Annual United States growth rates for wheat obtained from these secondary sources varied from 0.7 to 1.4 percent per year. Growth rates for shipments of farm products on the Great Lakes varied from zero growth to 0.3 percent per year. The Great Lakes/St. Lawrence Seaway Regional Transportation Study was the most harbor specific. This study indicated that domestic grain movements on the Great Lakes/St. Lawrence Seaway are expected to remain fairly stable from 1990 to 2050.

All five grain companies active within the Federal project were interviewed. The conclusion of the interview process was that the local grain industry foresees no future increase or decrease in its present market share. The level of grain receipts have stabilized over the last 10 years and were considered to be representative of future levels of grain receipts.

Table B11 indicates that grain receipts (barley and rye and wheat) for Buffalo Harbor has been slowly declining since the late 1950's. The development of low cost destination mills, favorable rail shipping rates for bulk flour from Kansas City, MO, to Barksdale, MD, above average labor costs at Buffalo mills and the long term decline in per capita flour consumption have all contributed to a slow decline in grain receipts.

Table B18 - Projected Commodity Tonnages - Buffalo Harbor (000's Short Tons)

Commodity/ Geographic Area	Project Year 1980	1990	1995	2000	2010	2020	2030	2040
Grain-Alternatives IId, IIe								
Buffalo Harbor	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4
Iron Ore-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Buffalo River								
Domestic	760.6	768.6	772.7	776.8	785.1	793.4	801.8	810.3
Union Canal								
Domestic	81.6	107.6	123.6	141.9	187.2	246.9	325.6	429.4
Foreign	24.4	32.1	36.9	42.4	55.9	73.7	97.3	128.3
Total	106.0	139.7	160.5	184.3	243.1	320.6	422.9	557.7
Lackawanna Canal								
Domestic	1,168.2	1,286.6	1,350.2	1,417.0	1,560.6	1,718.7	1,892.9	2,084.8
Foreign	563.6	633.9	672.2	712.9	801.8	901.7	1,014.1	1,140.6
Total	1,731.8	1,920.5	2,022.4	2,129.9	2,362.4	2,620.4	2,907.0	3,225.4
Limestone-Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Buffalo River								
Domestic	179.8	181.7	182.7	183.7	185.6	189.6	189.6	191.6
Union Canal								
Domestic	25.1	33.0	38.0	43.6	57.5	75.8	100.0	131.9
Lackawanna Canal								
Domestic	409.4	454.0	478.1	503.5	558.5	619.5	687.5	762.5
Sand and Gravel								
Buffalo Ship Canal-Alternatives IId, IIe								
Domestic	235.9	235.9	235.9	235.9	235.9	235.9	235.9	235.9
Outer Harbor-Alternatives IIe, IIf, IIIg, IIIh, IIIi, IVa, IVb								
Domestic	68.9	68.9	68.9	68.9	68.9	68.9	68.9	68.9

However, from 1971 to 1980 Buffalo received around 1.4 million short tons of grain per year. Grain receipts from 1976 to 1980 averaged 1,427,330 short tons and in 1980 were 1,446,369 short tons. Based upon the no growth scenario forecast by the Great Lakes St. Lawrence Regional Transportation Studies and the concurrence of this outlook during grain company interviews, 1980 grain receipts were considered representative of grain tonnages that would occur in 1990. Grain was assumed to be in a no growth scenario for the project planning period of 1990 to 2040.

c. Iron Ore - Regional studies were again examined to determine the level of iron ore movements expected on the Great Lakes in general and Buffalo Harbor in particular. National Waterways Study, Final Report, Traffic Forecasting Methodology and National Waterways Study, Evaluation of the Present Waterways System has identified national iron ore requirements as growing at an annual rate of between 2.2 and 3.3 percent between 1990 and 2003.

The National Waterways Study, Final Report, Traffic Forecasting Methodology concluded that demand for iron ore would remain constant between 1977 and 1990 and would then grow by 2.1 percent per year between 1990 and 2003. The Great Lakes St. Lawrence Regional Transportation Studies, Commodity Flow Forecasts, September 1981, presented annual iron ore growth rates by origin ports that have historically shipped iron ore to Buffalo. Iron ore receipts at Buffalo were projected to grow at an annual rate of 1.32 percent between 1990 and 2040 for all of the individual sourcing harbors.

Interviews and surveys of the three active iron ore dock operators indicated an even slower rate of growth. Historically, Table B11 shows that the average iron ore tonnage received at the harbor between 1976 and 1980 was 4,593,400 short tons. The ten year average is approximately 300,000 short tons more. However, 1980 iron ore receipts were only 2,598,322 short tons.

This downturn in iron ore tonnage is reflective of the U.S. steel industries current decline. The U.S. steel industry as a whole today is suffering from penetration of the domestic market by foreign steel producers. In the first quarter of 1981 steel imports comprised 13.9 percent of the U.S. market and 23.7 percent during the last three months of 1981. Continued market penetration by foreign steel producers will continue to depress the profit levels of the national industry. However, the funds necessary to modernize U.S. steel plants are expected to come from improved profits.

Many U.S. steel producers are old, poorly located and have too much capacity for the down-sized automobile industry and the near-term needs of the appliance and beverage can market. In order to become more competitive the U.S. steel industry is currently undergoing a major reorganization. The steel industry is emphasizing locations on the Great Lakes where water transportation of bulk commodities help keep raw material input costs down and insulates them from imported steel competition because of their greater distance from coastline ports. In 1981 a Federal tax cut program allowed for faster depreciation of plant and equipment and investment tax credits. The Council on Wage and Price Stability was disbanded and the steel industry was given an additional three years to comply with the Clean Air Act.

Based upon these developments the steel industry developed a capital spending program totaling $5.5 billion for improvements in furnaces, coke ovens, new continuous casters, etc. This expenditure program is based upon a rise in corporate earnings, a sharp drop in corporate debt, and a decrease in interest rates. Steel companies have also begun to tailor their product lines to those items which exhibit the most potential for long-term market growth.

(1) Upriver Iron Ore - The future growth of iron ore receipts at Buffalo Harbor is linked to three iron ore consumers located within the Federal project limits. The steel plant adjacent to the Buffalo River, located approximately 5 miles upriver, was considered as a participant in any transshipment alternative. This plant closed its steelmaking operations in April 1981 to refurbish its blast furnace and plant operations have been put on indefinite suspension since 25 May 1982 due to the depressed demand for steel.

A lack of steel orders stems from its heavy reliance on the automobile industry, which has suffered a record decline in production levels. More than 60 percent of the products made at the upriver steel plant are used in the automotive market. Future U.S. automobile production will require less steel due to the trend in recent years of downsizing domestic automobiles to increase gasoline mileage in order to compete with foreign imports. Also continued population shifts to the South will reduce demand for auto production and sales in the Northeast which is the basic market area for steel plants in Buffalo, NY.

In December 1981, this company announced a $112 million capital improvement program for locations in Chicago, IL, Youngstown, OH, and Gadsden, AL. Although the Buffalo plant was not included in these plans, the parent corporation has spent $50 million since 1978 to renovate and expand its Buffalo facility. From April 1981 to May 1982, the parent corporation had spent more than $20 million rebuilding the Buffalo facility's blast furnace and installing new air pollution control systems on both the blast furnace and basic oxygen furnace. Also electrical and computer equipment was installed that has a normal life expectancy of 25 to 30 years. Corporate officials have stated that the metal producing operation of the Buffalo plant is one of the most competitive in the United States and have indicated that the output of semi-finished carbon products will probably increase in the future and be shipped to other locations for final processing.

(2) Lakefront Iron Ore - Another iron ore dock is located adjacent to the Union Ship Canal. This company has been operating at limited production capacity since July 1979 when it shut down one of its two main blast furnaces. The company subsequently closed all operations in January 1982. More than half of their output was destined for the domestic foundry market which has historically relied upon pig iron imported from foreign producers. The balance of their output was shipped to a local company that made cast iron containers for molten steel for a steel company located in Detroit, MI. This steel company has subsequently installed continuous casting equipment. Competition from foreign suppliers and changes in domestic steel production techniques has resulted in the complete closure of the firm located at the Union Ship Canal.

The third and largest receiver of iron ore at Buffalo has its main docks located on the Lackawanna Canal. This company uses its iron ore receipts to produce steel and was the second largest steel producer in the nation in 1966 but declined to twelfth place in 1982. Employment at the Lackawanna plant has fallen from 19,500 in 1956 to 7,000 in 1980. The following operations have been phased out since 1970: four coke batteries, three blast furnaces, three structural steel mills, three bar mills, a 32 inch rail mill, a 40 inch blooming mill, a tin plate and slice bar shop, a pattern shop, an iron foundry and a lime plant. The parent corporation lost $66.7 million in the first quarter of 1982 and was attributed to the decline in automobile production. The current product mix includes hot rolled carbon and alloy bars and cold rolled and galvanized sheet metal. Principal markets are in cold finished bar products, fasteners, the automotive market for steel bars and sheet steel, cold formed shapes and highway products and are anticipated to continue into the future. The existing facility has been producing approximately 2.5 million tons of steel a year although it has a rated capacity of 3.5 million tons.

A 5-year $750 million modernization program was announced in August 1981 for its plants located in Sparrows Point, MD, Burns Harbor, IN, Bethlehem and Steelton, PA, and others. The Lackawanna plant was not included in this near-term capital investment program. However, capital expenditures at the Lackawanna plant have exceeded $560 million between 1970 and 1980. A new 13-inch bar mill was constructed at the Lackawanna plant in 1970 at a cost of $143 million. Since 1981 $10 million has been spent modernizing its galvanizing line and $17 million on an open air pollution system project for its scinter operation.

After consideration of the previous information, derivation of an iron ore forecast based upon applying an industry, or regional growth rate to a 5 or 10-year average of harbor iron ore receipts is not considered representative of future iron ore needs. Therefore, based upon levels of historical iron ore receipts, and interviews and surveys conducted with the local iron ore users, future iron ore needs in Buffalo are expected to approximate some historical level of iron ore receipts.

Information derived from the surveys and interviews on future production levels was heavily relied upon in making forecasts of future Buffalo Harbor iron ore needs. Forecasts were made for each of the three companies described earlier: those located on the Buffalo River, Union Canal and Lackawanna Canal. The forecasts assumed that the iron ore needs at each location in 1980 would be a representative starting point since current production levels are curtailed. Average iron ore tonnages by each company from 1976 to 1980 were computed and were then used as the maximum amount of iron ore that would be demanded in the future. The amount of iron ore demanded in any given year for each company was derived by interpolation using a deferred growth curve. This approach acknowledges currently depressed production levels and the lack of information about near-term prospects. However, the long-term outlook for production in Buffalo was assumed to rapidly recover in the last portion of the projection period.

The average annual growth rate for total iron ore receipts between 1980 and 2040 was 0.95 percent per year. This average annual growth rate was below the 1.32 percent annual growth rate between 1990 and 2040 used in the Great Lakes-St. Lawrence Regional Transportation Studies, Commodity Flow Forecasts, September 1981. This growth rate was also below the 2.1 percent annual iron ore growth rate used in the National Waterways Study, Final Report Traffic - Forecasting Methodology, August 1981 for the years 1990 to 2003.

An analysis of individual blast furnace capacities at each location was made to insure that the iron ore tonnage forecasts were not greater than the raw materials required by the blast furnaces. There are nine blast furnaces in Buffalo with a combined pig iron production capacity of 5,700,000 net tons per year. Future iron ore needs, based upon its pig iron production capacity, can be obtained by inferring a relationship about raw material inputs. These assumptions took into account unforseen productivity increases. A ratio of 1.5 to 1 iron ore to pig iron was assumed. Thus, based upon the ratio of existing pig iron production capacity of 5,700,000 net tons, maximum iron ore needs are 8,550,000 net tons per year. The maximum amount of iron ore based upon the projections is 4,593,400 net tons in 2040.

A second check on the iron ore projections was based upon the iron ore and steel production needs of the plants located in the three geographic areas discussed: the Buffalo River, Union Canal, and Lackawanna Canal. The iron ore needs of any one geographical location was based upon the production process (making pig iron or making steel) that demanded the least amount of iron ore input requirements. This was done to identify production bottlenecks which might require iron ore. The iron ore production demands at any of the three geographical areas was compared to the iron ore tonnage forecast for that area. In all cases the projected iron ore needs were 60 percent or less of full production demands for iron ore.

Forecasts of foreign iron ore receipts were needed for docks adjacent to the Lackawanna and Union Canals only since all future iron ore receipts at the upriver location will be sourced indirectly via a transfer dock at Lorain, OH, which receives material from upper lakes ports. Foreign ore receipts were based upon the ratio of historical receipts of foreign iron ore to total iron ore receipts for those two areas from 1976 to 1980. A 5-year average of this ratio was determined and assumed to remain constant over the planning period 1990-2040. This ratio was applied to the total iron ore receipts forecast for these two areas.

Figure B2 compares the expected level of recovery to historical levels of iron ore receipts. The projected 2040 values for all three locations are at the most 85 percent of the highest recorded level of iron ore receipts between 1976 and 1980.

None of the iron ore users have announced a permanent closing of their facilities. Therefore, it is assumed that in the next 8 years these facilities will resume operations and require the iron ore and limestone inputs

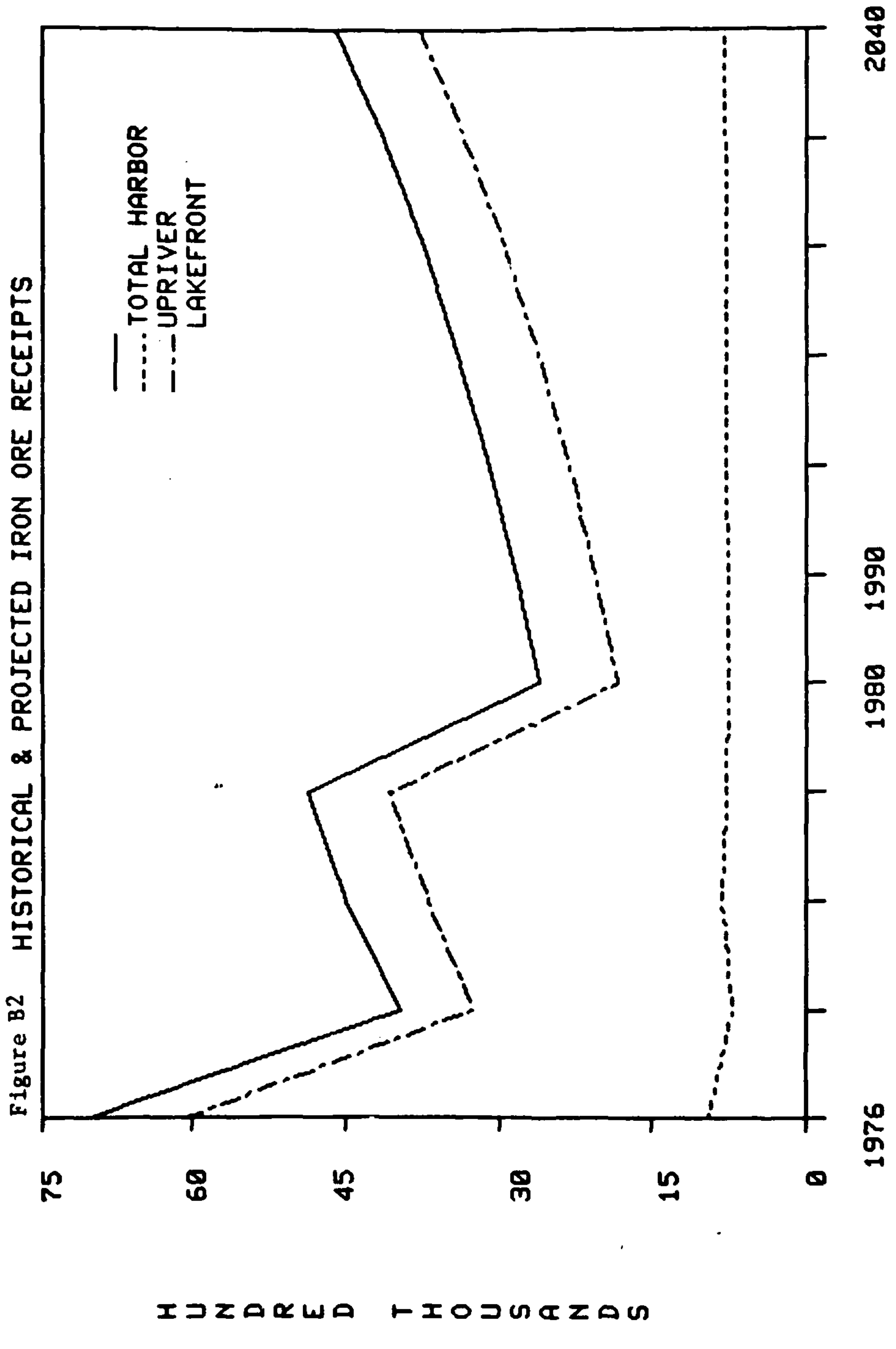


Figure B2 HISTORICAL & PROJECTED IRON ORE RECEIPTS
TOTAL HARBOR
UPRIVER
LAKEFRONT
75
60
45
30
15
0
1976
1980
1990
2040
HUNDRED THOUSANDS

Figure B2

demanded in 1990. However, any change in the operating status of any one of the three iron ore users must be taken into consideration in future stages of the study by adjusting the iron ore and limestone projections of Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, and IVb.

d. Limestone - Limestone receipts at Buffalo are heavily linked with iron ore movements. Historically over 90 percent of all limestone destined for Buffalo Harbor was used by Buffalo pig iron producers. Since only the limestone used by Buffalo pig iron producers would be impacted under any improvement alternative, limestone projections were assumed to be 23 percent of the three areas iron ore tonnage needs. This percentage was developed from historical data from all three locations for the time period 1976-1980.

e. Sand and Gravel - Sand and gravel traffic is used primarily by the automobile and construction supply industries. This traffic takes place in the Outer Harbor and on the Buffalo Ship Canal. It was assumed to be in a no growth situation and is based upon field surveys and coordination with individual dock operators. The sand and gravel receipts were assumed to equal the average tonnages received at these two locations from 1976 to 1980.

B4. UNIT TRANSPORTATION COSTS

A key component in evaluating the economic impacts of harbor improvements at Buffalo is the potential change in the size, operating characteristics, and resultant cost of vessel operation. The anticipated makeup of the fleet under without- and with-project conditions affects the level of benefits as does the sourcing patterns of bulk commodities destined for Buffalo Harbor. The water transportation costs per ton for bulk commodities consists of all fixed and variable charges that are applicable to a shipping season divided by the number of tons moved per season. These costs are usually computed from when the commodity leaves the orgin port to when the commodity is discharged at the destination dock. In most instances the commodity is delivered directly to the destination dock. This cost per ton is called the required freight rate. All the commodities affected by any improvement alternative proposed for Buffalo Harbor incurs these required freight rate costs. However whenever a commodity is lightered (Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb) or transshipped (Alternatives IIIf, IIIg, IIIh, IIIi), there are transportation costs incurred that are above and beyond water transportation costs. These costs consist of ground storage charges and an additional cost per ton to deliver the bulk commodity to its final destination dock. The additional "transshipment" charges would be for truck (lightering), rail or shuttle vessel delivery of the bulk commodity to the final destination dock. These water transportation costs and transshipment charges will be discussed in more detail.

a. Water Component of Transportation Costs.

A required freight rate analysis was performed to estimate the water component of transportation costs by commodity. The required freight rate (RFR) is defined as the level of income per ton of cargo necessary to produce an after tax yield of 10 percent on an all-equity investment. The most significant costs which confront the owner/operator of a Great Lakes vessel consist of the annual fixed and variable costs associated with operating that vessel. These costs vary by vessel size.

Vessel construction and operating costs developed by the Maritime Administration, U.S. Department of Transportation (MARAD) were used to estimate annual transportation costs for various vessel sizes. The Maritime Administration's vessel classification system was used to group vessels into classes by length and is presented below.

Vessel Class	Vessel Length
1	Less than 400
2	400-499
3	500-549
4	550-599
5	600-649
6	650-699
7	700-730
8	731-849
9	850-949
10	950-1,099

Assumptions on rates of return, economic and engineering life cycles, and the expected length of the navigation season were important components in determining annual transportation costs. Annual transportation costs were then divided by the number of tons per season that the vessel could carry, assuming a certain maximum operating draft, between the origin or destination ports.

Freight rate differentials resulting from different vessel sizes and/or operating characteristics on a particular trade route were used in quantifying benefits for proposed channel modifications. An overview of the derivation of "required" freight rates is shown in Figure B3.

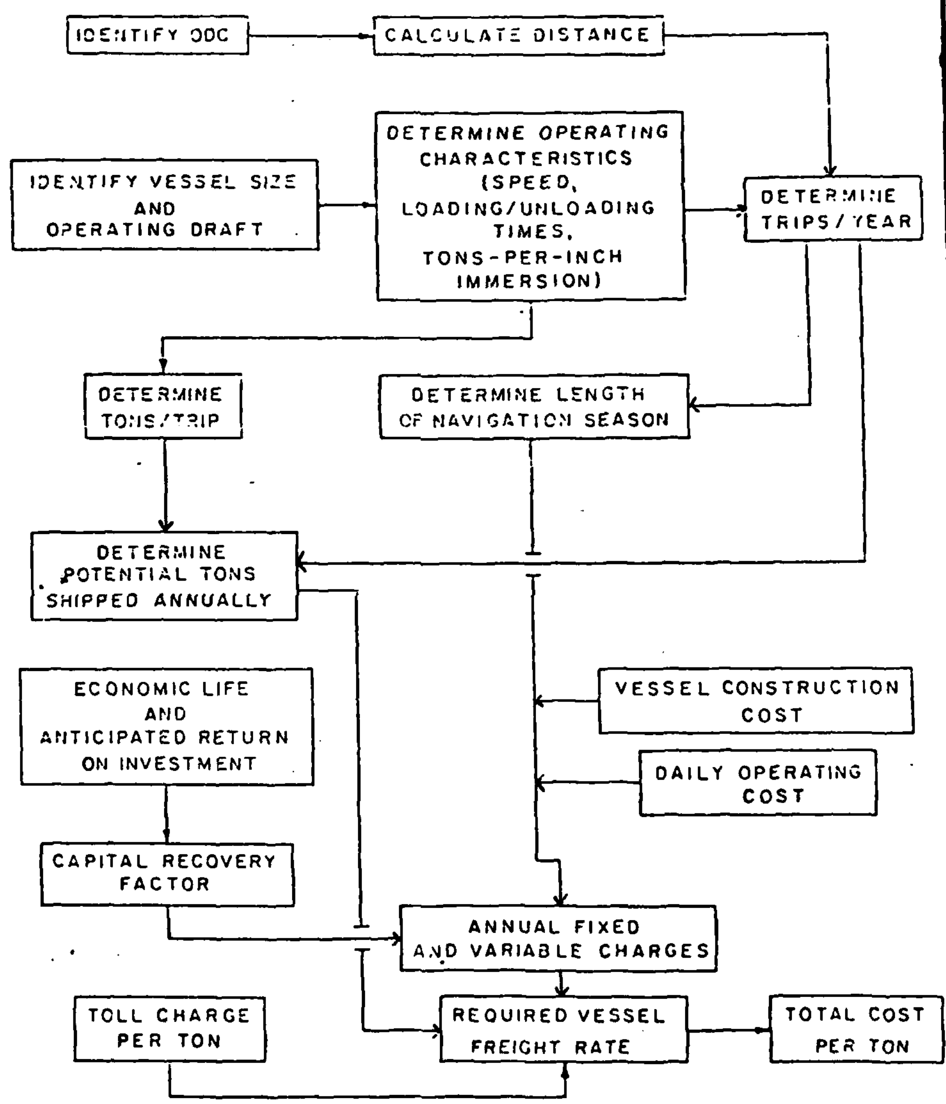


Figure B3 DERIVATION OF VESSEL TRANSPORTATION COSTS

(1) Required Freight Rate Equation - The required freight rate of a particular vessel size operating at a specific draft can be expressed in the following terms:

$$\frac{\left[a(b) + c(d)\right]}{\left[\dfrac{c}{2\left[\dfrac{e}{f} + \dfrac{g}{h} + i\right]} \times e\right]}$$

where, a is the construction cost for a specific size/type of vessel,
b is a capital recovery factor,
c is the length of the navigation season,
d is the daily operating expense of the vessel,
e is the carrying capacity of a specific size of vessel at a particular draft,
f is the unloading/loading rate,
g is the one-way open-lake distance between the origin and destination,
h is average open-lake speed, and
i is the time required to traverse locks and harbor maneuvering time.

(2) Vessel Investment Assumptions - The numerator of the required freight rate formula consists of the annual fixed charges and the annual variable costs facing the vessel operator, depending on the length of season. These charges change by vessel class, commodity and trade routes.

The annual fixed and variable costs for vessel classes used in the "without" and "with project" condition were based on data supplied by the Maritime Administration adjusted to June 1982 prices. This information is presented in Table B19.

Fixed transportation costs associated with the grain trade reflect the relative age of the existing fleets. Vessels used to transport grain to Buffalo have an average age of over 50 years and many, if not all, of these ships serving Buffalo elevators are fully amortized. This allows these vessels to be operated profitably at low freight rates. Future vessel investment costs are based upon periodic rehabilitation costs of a fully depreciated vessel, as opposed to new vessel construction costs. Five grain companies currently hold a 50 percent ownership interest in the grain vessels servicing their docks. In the future they do not foresee constructing new vessels to

service their grain needs. Interviews with the grain companies indicated that in order to keep transportation costs to a minimum, the buying of a fully depreciated older class 5 grain vessel is a possible future alternative for this industry when its present fleet needs to be replaced.

Variable b, the capital recovery factor, 0.1308, is based on an expected after-tax yield on investment of 10 percent with a corporate tax rate of 48 percent and a vessel economic life of 50 years. The season length (variable c) was assumed to be 275 days, or 6,600 hours.

(3) Vessel Operating Characteristics for Specific Orgin-Destination Pairs - The denominator of the required freight rate formula is potential tonnage moved during the navigation season. Required freight rates for each origin-destination trade route reflect geographic factors, i.e., distance, and vessel-specific features, i.e., tons per trip, and average open-lake vessel speeds. Prototype vessels by reach and by commodity were used in this analysis. Table B19 illustrates the vessel clasification system and the Buffalo Harbor prototype for each commodity.

(4) Determination of Maximum Operating Draft - "Static draft," in the case of all vessels, is the distance from the water surface to the lowest point of the vessels's hull under water measured when the vessel is not moving. Maximum operating draft (MOD) is the draft the vessel can safely load to when a design storm condition is occurring. It is derived by integrating characteristics such as the speed and size of the vessel, the depth and width of the channel, and the effects of the design storm condition on vessel movement.

Individual vessel movements most critically affecting the depth required at a given static draft is shown in Figure B4. Squat is the combined effect of bodily sinkage and change in trim while a vessel is under way. Roll is the rotation of a vessel around its longitudinal axis which is induced primarily by wave action with a force normal to the port or starboard side of the vessel. The equations to determine each are:

$$S = \frac{V_1^{2}}{2g} \left[\left(1.01 \frac{A_1}{A_w}\right)^{2} - 0.84 \right] \qquad \text{(a)}$$

where: S = squat at speed V_1 (feet)
V_1 = ship velocity (feet/second) relative to water
A_1 = channel cross sectional area (square feet)
A_w = Channel cross sectional area less ship cross sectional area (square feet)
g = 32.2 ft/sec^2

and

$$Y = \frac{B}{2} \sin \theta \qquad \text{(b)}$$

Table B19 - Summary of Fleet Prototypes

Harbor Reach Commodity	Vessel Class 10	8	7		6	5					4	5
			Lakefront									
	Lakefront Ore	Lakefront Ore	Domestic St/S&G	Canadian Ore	Lakefront St/S&G	Upriver Ore	Upriver ST/S&G	Upriver Grain	Lakefront Ore	Lakefront ST/S&G	Lakefront Ore	Shuttle Vessel Ore
Deadweight Tonnage (Short Tons)	88,312	36,000	41,664	29,288	24,976	25,984	26,656	14,877	17,444	26,656	14,784	25,984
Approximate Length (Feet)	1,000	826	730	715	698	634.9	634.8	630	620	634.8	574.4	634.9
Mid-summer Draft (Feet)	34	28.2	30.9	27.2	26.9	27.9	28	21.1	25.5	28	24.9	27.9
Immersion Factor (Tons Per Inch)	267	146	141	130	113	108	106	88	86	106	74	108
Daily Vessel Operating Expenses (Dollars)	26,400	20,200	19,200		18,700	17,700		17,700	17,700		17,100	16,000
Estimated Construction Cost ($ Millions)	70M	45M	41M		36M	33M		.325M(1)	33M		26M	30M

(1) Investment cost, not construction cost. Reflects periodic rehabilitation of fully depreciated vessels. (Vessels in the grain trade at Buffalo Harbor average over 50 years in age).

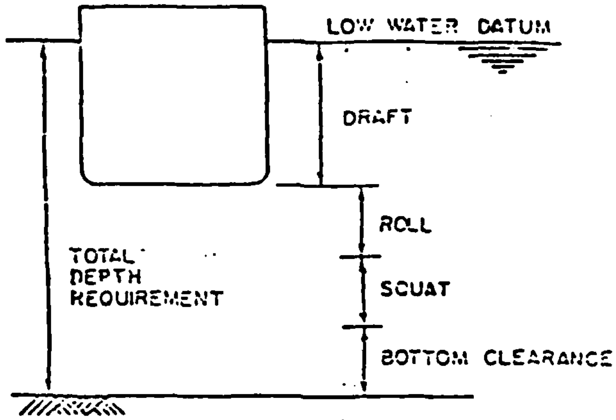
(2) ST/S&G = Limestone, Sand and Gravel.

NOTE: Physical characteristics of Prototype vesels are based upon vessels actually in service at the harbor or expected to transport the majority of the commodity flow to a specific Harbor Reach.

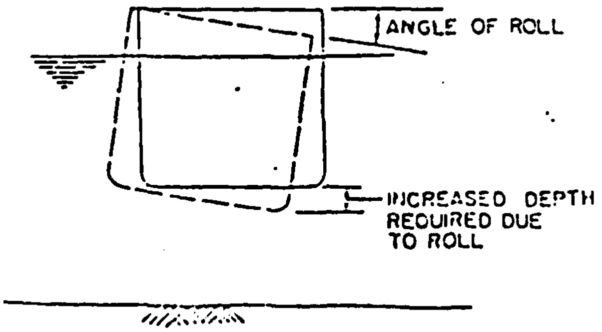
SOURCE: Maritime Administration, U.S. Dept of Transportation letters dated 25 June 1981 and 14 December 1979. Adjusted to June 1982 prices based upon historical increases in estimated variable and construction costs.

Figure B4

Definition of Depth Criteria

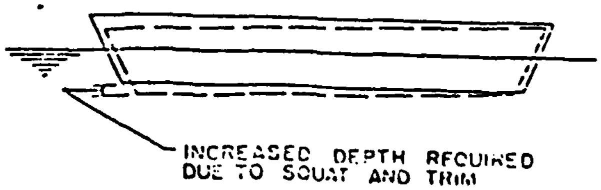


DEFINITION OF
TOTAL DEPTH REQUIREMENTS



DEFINITION OF ROLL

The motion of a vessel about its longitudinal axis induced primarily by wave action.



DEFINITION OF SQUAT AND TRIM

SQUAT The combined effect of bodily sinkage and change in trim while a vessel is in motion.

TRIM The difference between the draft of a ship forward and that aft.

where:

Y = depth requirement due to roll (ft)
B = composite vessel beam (ft)
θ = roll in degrees

A 2-foot safety bottom clearance is required by ER 1110-2-1404, Engineering and Design, Deep Draft Navigation Project Design. This safety clearance is added to the subtotal of equations (a) and (b) to determine required channel depth. The maximum operating draft is determined when static draft and safety clearance under design storm conditions required by a vessel operating within a specified navigation channel equals the available channel depth. The components of the required channel depths are presented in Figure B3.

The harbor improvement alternatives were designed to safely allow vessel operation under 30 knot winds and 8-foot wave storm conditions. The following values are used to reflect vessel movement under design storm conditions: a maximum harbor entrance speed of 6 miles per hour (8.8 feet per second), for all vessels, a 4-degree roll for 1,000-foot vessels, and a 6-degree roll for all other vessels.

The harbor improvements permit all ships to safely enter the port fully loaded while the design storm condition prevails. This analysis assumes depths presently available within the connecting channels of the Great Lakes/St. Lawrence Seaway System are sufficient to allow vessel operation at a maximum draft of 25.5 feet. If the other port in the O/D pair has depths equal to or less than channel depths in Buffalo, no benefit was credited to that particular commodity movement.

(5) Required Freight Rate Calculation - A sample required freight rate calculation is presented in Table B20. The calculation is for an iron ore movement from Superior, WI to Buffalo, NY. The maximum operating draft allowed by existing channel depths in the south Outer Harbor for a Class 10 vessel is 22.5 feet. The most critical variable affecting potential tonnage moved is maximum operating draft. Therefore, lake freight transportation costs presented in this appendix show draft as the independent variable.

Required freight rates were calculated for the various vessel sizes and commodities affected by the various project alternatives. These required freight rates were calculated for the "without" and "with-project" conditions and are presented by alternative in Table B21 and B22 respectively.

Table B20 - Required Freight Rate Illustration

Commodity	Iron Ore
Harbor Destination	Buffalo Harbor, NY
Harbor Origin	Superior, WI
Vessel	Class X
Vessel Dimensions	1,005 feet overall length by 105-foot beam'
Vessel Mid-Summer Draft (MSD)	34 feet
Existing Channel Depth	28 feet LWD
Maximum Vessel Operating Draft	22.5 feet LWD
Vessel Carrying Capacity at MSD	88,300 net tons
Approximate Capacity Per Inch of Draft at MSD	267 net tons
Carrying Capacity Adjusted to Maximum Operating Draft	34 feet - 22.5 feet = 138 inches 88,300 - (138 x 267) = 51,454 say 51,500
One-Way Open-Lake Distance	978 miles
Average Speed	15 mph
Unloading/loading Rate	6,700 tons/hour
Length of Navigation Season	275 days (6,600 hours)
Hours/Round trip	Allowance for One-Way Lockage at Soo Locks: 4 hours; 51,500/6,700 = 8 hours loading; 978/15 = 65 hours in transit, inner harbor maneuvering = 1 hour; (4 + 8 + 65 + 1) 2 = 156 hours/round trip
Maximum Number of Round Trips/Year	6,600/156 = 42
Potential Annual Tonnage	51,500 x 42 = 2,163,000
Economic Life of Vessel	50 years
Initial Investment	$70 million
Capital Recovery Factor for 50 years	0.1308
Daily Vessel Operating Cost	$26,440
	$RFR = \frac{(\$70 \text{ million})(0.1308) + (275)(\$26,400)}{2,163,000} = \$7.59/\text{Net ton}$

Table B21 - Required Freight Rates for "Without Project" Conditions

Commodity/Alternative/Reach	Vessel Class	Maximum Operating Draft (Feet)	Required Freight Rate ($/ton)
Iron Ore - Alternatives: IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb			
Buffalo River: Domestic	5	23.0	8.20 (a)
Union Canal: Domestic	5	23.0	14.40
Foreign	7	22.5	13.10
	4	23.5	14.00
Lackawanna Canal: Domestic	10	22.5	7.25
Domestic	8	22.5	10.45
Foreign	7	22.5	13.05
Limestone - Alternatives: IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb			
Buffalo River: Domestic	5	23.0	7.35
Union Canal: Domestic	5	23.0	6.05
Lackawanna Canal: Domestic	6	23.0	7.20
Grain - Alternative : IId, IIe			
Buffalo River and Canal: Domestic	5	19.5	11.20
Sand and Gravel			
Buffalo Ship Canal - Alternatives IId, IIe			
Domestic	5	19.5	10.20
Outer Harbor - Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb			
Domestic	7	22.5	10.80

(a) Includes total costs of iron ore movement from the upper lakes to Lorain Harbor, OH, via a 1,000 Feet X 105 Feet maximum size vessel, followed by reloading into a Class 5 vessel which proceeds to Outer Harbor public docks in Buffalo Harbor, NY, where partial lightering occurs. The vessel subsequently unload the balance of its cargo at a destination dock on the Buffalo River.

Table B22 - Required Freight Rates for "With-Project" Conditions

Commodity/Reach/Alternative	Vessel Class	Maximum Operating Draft (Feet)	Required Freight Rate ($/ton)
Iron Ore			
Buffalo River - Alternatives: IIe, IVa			
Domestic	10/5	25.5	7.95
Buffalo River - Alternatives: IIIf, IIIg, IIIh, IIIi			
Domestic	10	25.5	6.25
Buffalo River - Alternative: IVb			
Domestic	10/5	24.5	8.05
Union Canal - Alternatives: IIe, IVa			
Domestic	5	25.5	12.55
Foreign	7	25.5	11.10
	4	25.5	12.75
Union Canal - Alternatives: IIIf, IIIg, IIIh, IIIi			
Domestic	10	25.5	6.25
Union Canal - Alternative: IVb			
Domestic	5	24.5	13.35
Foreign	7	24.5	11.75
	4	24.5	13.15
Lackawanna Canal - Alternatives: IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb			
Domestic	10	25.5	6.25
	8	25.5	8.90
Foreign	7	25.5	10.80

Table B22 - Required Freight Rates for "With Project" Conditions (Cont'd)

Commodity/Reach/Alternative	Vessel Class	Maximum Operating Draft (Feet)	Required Freight Rate (Per ton)
Limestone			
Buffalo River - Alternatives: IIe, IIIf, IIIg, IIIh, IIIi, IVa			
Domestic	5	25.5	5.20
Buffalo River - Alternatives: IVb			
Domestic	5	24.5	5.50
Union Canal - Alternatives: IIe, IIIf, IIIg, IIIh, IIIi, IVa			
Domestic	5	25.5	5.30
Union Canal - Alternative: IVb			
Domestic	5	24.5	5.60
Lackawanna Canal - Alternatives: IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb			
Domestic	6	25.5	6.30
Grain			
Buffalo River and Canal - Alternatives: IId, IIe			
Domestic	5	21.1	10.10
Sand and Gravel			
Buffalo Ship Canal - Alternatives IId, IIe			
Domestic	5	22.5	8.35
Outer Harbor - Alternatives IIe, IIIf, IIIg, IVa			
Domestic	7	25.5	9.35
Outer Harbor - Alternatives IIIh, IIIi, IVb			
Domestic	7	24.5	9.85

b. Transshipment.

(1) Overview. In the past, direct delivery to upriver ore docks, was economically justifed as larger vessels were introduced to Great Lakes service. The Buffalo Harbor Reconnaissance Report revealed that extensive Buffalo River modifications to accommodate maximum size self-unloading vessels were not feasible and that transshipment from the lakefront could possibly be more cost effective. In an attempt to maximize net benefits, a range of alternatives providing access for 1,000-foot vessels to lakefront harbor areas has been developed. Therefore, transshipment modes such as conveyor, truck, special purpose barge, special purpose vessel, and rail have been considered in this report.

(2) Lightering. Ore receivers on the Buffalo River and Union Canal currently find it advantageous to truck a portion of their ore requirements which are delivered in 730-foot or smaller vessels to NFTA public docks. This activity, commonly called "lightering", reduces the loaded draft at the NFTA docks located in the Outer Harbor, to that permitted on the Buffalo River or Union Canal. Lightering is assumed to continue in the "With Project" condition under Alternatives IIe, IVa and IVb. Under the first two alternatives, iron ore vessels would have an increase in maximum operating draft from 23 feet to 25.5 feet. Under Alternative IVb, the maximum operating draft of iron ore vessels would increase from 23 feet to 24.5 feet. The current maximum operating draft for vessels into the Outer Harbor behind the South Breakwater is 24.5 feet. Current Harbor depths in the area near the Niagara Frontier Transportation Authorities public piers are 27 feet. A safety factor of 2.5 feet in the Outer Harbor is necessary to compensate for keel clearance and roll and squat conditions in the Outer Harbor. Therefore the maximum operating draft to the Outer Harbor is 24.5 feet.

Under current conditions the maximum operating draft for these iron ore vessels entering the South Entrance is 23 feet after safety factors have been added on to compensate for roll and squat. Alternative IVb improves the South Entrance to allow 25.5 feet of operating draft. Therefore the geographic area that limits the draft for ore vessels that "lighter" under Alternative IVb is the maximum operating draft allowable of 24.5 feet in the approach to the NFTA public docks.

This lightering activity generates two costs: a cost for transporting the lightered tons from the Outer Harbor to the final stockpile destination via truck (transshipment costs) and a storage charge for leaving the commodity at the Outer Harbor for the period of time it takes to remove the commodity to its final stockpile destination.

Truck transshipment costs were evaluated using the following inputs: operating costs per day for a 25-ton dump truck; truck round trip times from NFTA to the final stockpiles located on the Buffalo River and Union Canal, a season length of 275 days, and the number of tons transshipped in a season. Storage charges were based on a monthly charge of $.74 per ton which is charged at other harbors along Lake Erie. This monthly charge was prorated based upon the amount of time it took to remove the lightered tons from the

Outer Harbor to the final destination stockpile. This cost was dependent upon truck round trip cycle time, truck carrying capacity and the amount of tons lightered which varied with vessel size and maximum operating draft in the Outer Harbor, the Buffalo River and Union Canal.

It is also assumed that lightering of limestone will take place at the NFTA docks under the "without project" condition. Limestone lightering is currently not performed by the limestone receivers located on the Buffalo River and Union Canal. These two companies could benefit from such a lightering operation since the current maximum operating drafts of the existing Federal channels in the Buffalo River and Union Canal are 19.5 and 18.5 feet, respectively. Currently the Buffalo River and Union Canal are maintained to a depth of 22 and 21 feet respectively. A safety factor of 2.5 feet for roll and squat and keel clearance results in a maximum operating draft of 19.5 and 18.5 feet respectively in the Buffalo River and Union Canal.

Transportation costs per ton for the two users were derived based upon direct delivery with vessel maximum operating drafts limited to that allowable on the Buffalo River and Union Canal. This was compared to delivery costs per ton based upon full utilization of present Outer Harbor depths of 23.0 feet by lightering at the NFTA public docks, direct delivering the remaining tons and trucking the lightered tons to the destination docks. This analysis showed that a slight savings could be realized if the lightering activity was implemented. As more iron ore is needed for production pruposes, so is limestone. The higher limestone tonnages will increase the limestone transportation savings due to increased lightering and thus make these transportation savings more attractive to capture.

Under improved project conditions lightering of limestone will cause total limestone transportation costs to decrease even further. Alternatives IIe, IIIf, IIIg, and IVa will provide a maximum operating draft of 25.5 feet, in the Outer Harbor at the NFTA docks. Alternative IVb will allow a maximum operating draft of 24.5 feet in the Outer Harbor at the NFTA public docks. Alternatives IIIh and IIIi will provide a maximum operating draft of 25.5 feet at Independent Cement. These operating drafts are above the current maximum Outer Harbor draft of 23 feet which is imposed by the South Entrance channel.

An analysis of limestone lightering costs (transshipment and storage costs) similar to that performed for iron ore was made.

"With and Without Project" lightering costs (transshipment and storage charges) per ton by project alternative are presented for iron ore and limestone in Table B23. These iron ore and limestone lightering costs will be used to determine the "without" and "withproject" transportation costs by alternative for these two commodities in Section B5. Storage charges for iron ore were approximately 5 cents ($.05) per ton. Storage charges for limestone were negligible due to the low number of tons lightered on each vessel trip. The balance of the lightering cost consisted of the overland truck line-haul charges.

Table B23 - Lightering Costs, Iron Ore and Limestone

Commodity/Location	Cost Per Ton In Dollars						
	1990	1995	2000	2010	2020	2030	2040
<u>Without Project Lightering Costs</u>							
Iron Ore IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb							
Buffalo River	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Union Canal							
Domestic	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Foreign	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Limestone IIe, IIIf, IIIg, IIIh, IVa, IVb							
Buffalo River	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Union Canal	1.50	1.50	1.50	1.50	1.50	1.50	1.50
<u>With-Project Lightering Costs</u>							
Iron Ore IIe, IVa							
Buffalo River	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Union Canal							
Domestic	1.65	1.65	1.65	1.65	1.65	1.55	1.55
Foreign	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Iron Ore IVb							
Buffalo River	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Union Canal							
Domestic	1.60	1.60	1.60	1.60	1.60	1.60	1.55
Foreign	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Limestone IIe, IIIf, IIIa, IVb							
Buffalo River	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Union Canal	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Limestone IIIh, IIIi							
Buffalo River	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Union Canal	1.10	1.10	1.10	1.10	1.10	1.10	1.10

(3) Transshipment - In contrast to the lightering operation where only a portion of the bulk commodity is lightered and then transported via truck, all transshipment options (IIIf, IIIg, IIIh, IIIi) assume that the design vessel ore load would be unloaded at a central location and the iron ore transshipped either via rail or special purpose shuttle vessel. These alternatives assume all of the iron ore needed by the iron ore companies located on the Buffalo River and Union Canal respectively will be delivered to the Outer Harbor in Class 10 vessels. No transshipment of limestone was considered.

Non-Federal interests are responsible for and bear the costs of the rail or shuttle vessel terminal and transshipment facilities, dredging of access channels adjacent to their docks, acquisition of lands, easements, rights-of-way, and utility relocations. The use of Class 10 vessels in the Outer Harbor under the transshipment Alternatives (IIIf, IIIg, IIIh, IIIi) will therefore result in non-Federal interests incurring a large share of the total cost of harbor navigation improvements.

Changes in annual transportation costs per ton between existing and improved conditions must reflect the additional economic or financial costs required to deliver iron ore from the lakefront transshipment facility via the appropriate mode of transshipment (rail or shuttle vessel) to destination stock-piling areas. These delivered costs would include all applicable rail or shuttle vessel transshipment costs plus the ground storage costs associated with these two modes of transhipment. These costs will be discussed further.

A lakefront transshipment plan will result in a lower transportation cost per ton attributed to the use of larger veessels, but will also result in greater annual transshipping costs than those currently incurred. Greater volumes will be transshipped with concomitantly greater storage charges at the transfer point.

(a) Rail Transshipment Costs - The transshipment costs per ton via rail were determined based upon certain railroad fixed and variable operating costs. The fixed costs consist of charges for locomotive and rolling stock cost (i.e., rail cars). Variable costs were composed of such items as diesel fuel, engine-house supplies, general maintenance costs, rail car maintenance costs, and labor costs.

This information was used in conjunction with round trip times for trains servicing the two iron ore users from the transshipment points located at the Niagara Frontier Transportation Authority docks and the Independent Cement Corporation location. A navigation season length of 275 days was used in the analysis.

A cost per ton for delivering iron ore to the Buffalo River and Union Canal from each of the two proposed transshipment locations: NFTA and Independent Cement were developed. This delivered cost per ton decreases over time since

added variable costs of delivering more tons per year is a very small percentage of the total costs (fixed and variable) involved. This small increase in total transshipment costs in future project years are spread over an increasing number of tons transshipped. Transshipment charges for rail ranged from $1.00 in 1990 to $0.65 in 2040.

Associated storage with the rail transshipment option were also developed. Storage charges were based on the prorated amount of iron ore destined for each destination dock and a given unit train size, round trip cycle times and an initial delivery of iron ore to the transshipment facility. Storage charges for iron ore destined for the Buffalo River ranged from 25 cents to 15 cents per ton. Storage charges for iron ore destined for the Union Canal were 5 cents per ton. The balance of the rail transshipment cost per ton was the cost per ton needed to cover all the fixed and variable costs incurred in the rail-haul of iron ore to the two final users from each of the transshipment facility sites.

The total transshipment and storage charges associated with a rail transshipment facility located at NFTA or Independent Cement are presented in Table B24. These transshipment costs will be used in calculating the "with project" condition transportation costs for the two rail transshipment alternatives (IIIg, and IIIh).

The transshipment costs per ton for a shuttle vessel were based upon a required freight rate analysis and the physical and financial characteristics of the shuttle vessel are presented in Table B19. A cost per ton value was determined for transshipping iron ore from both transshipment locations to the iron ore users located on the Buffalo River and Union Canal. The transshipment cost per ton for iron ore delivered to the Buffalo River or Union Canal varies due to the differences in round-trip times and the maximum operating draft associated with the two final destination points. Shuttle vessel transshipment costs per ton were $1.25 to deliver iron ore to the Buffalo River and 75 cents to deliver iron ore to the Union Canal from either transshipment location.

Due to the carrying capacity of the shuttle vessel, storage charges were negligible and were not included in the estimate of final total transshipment costs. The total transshipment charges associated with a shuttle vessel transshipment facility located at NFTA or Independent Cement are presented in Table B24. These transshipment costs will be used in calculating the "with project" condition transportation costs for the two shuttle vessel transshipment alternatives (IIIf, and IIIi).

Table B24 - Transshipment Costs

Commodity/Mode of Transshipment	Cost Per Ton in Dollars						
	1990	1995	2000	2010	2020	2030	2040
Iron Ore							
Shuttle Vessel - From NFTA (1), IIIf							
Buffalo River	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Union Canal	.75	.75	.75	.75	.75	.75	.75
Rail - From NFTA, IIIg							
Buffalo River	1.25	1.15	1.15	1.10	.95	.90	.80
Union Canal	1.05	1.00	1.00	.95	.85	.80	.70
Rail IIIh - From Independent Cement, IIIh							
Buffalo River	1.25	1.15	1.10	1.05	.95	.85	.80
Union Canal	1.00	1.00	.95	.90	.85	.75	.70
Shuttle Vessel From Independent Cement, IIIi							
Buffalo River	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Union Canal	75	.75	.75	.75	.75	.75	.75

(1) The shuttle vessel is expected to be in operation at other ports in the Great Lakes or Lake Erie. Therefore, other commercial traffic can be expected to incur the balance of the annual operating costs.

B5. FUTURE TRANSPORTATION COSTS BY ALTERNATIVE

a. Introduction - Future transportation costs are needed to determine future benefits accruing to any proposed plan of improvements. Transportation costs are calculated for the "without" and "with project" condition for each alternative. The difference between the "without project" and "with project" transportation costs for each alternative are the transportation cost savings associated with the implementation of that alternative. This time stream of "net" transportation cost savings are then converted to average annual equivalent values and used as a proxy for transportation benefits associated with that alternative.

These transportation costs are derived by using the required freight rates, lightering and transshipment costs, vessel fleet composition and traffic forecasts developed for the "without" and "with project" condition for each alternative being evaluated.

The following assumptions were used in determining future transportation costs. The commodity sourcing patterns presented in Section B2c will not change during the project evaluation period. Vessel fixed and variable operating costs and vessel loading/unloading rates will not change over time. Therefore the "without" and "with project" condition required freight rates will remain constant over the 50-year evaluation period. These transportation costs per ton for the "without" and "with project" condition are presented in Tables B21 and B22 respectively. It is also assumed that the lightering and transshipment costs presented in Tables B23 and B24 would be in effect for the 50-year evaluation period.

The future fleet composition by project alternative, harbor reach and commodity changes over the evaluation period between the "without" and "with project" condition, as outlined in Tables B15 and B16 respectively.

The affected tonnage projections of Table B18 were allocated among vessel classes based upon the projected percentage of tonnage moved by vessel class for the "without" and "with project" condition, Tables B16 and B17 respectively. This was done for each project alternative.

The result is a forecast by project alternative of affected tonnages moved by vessel class. These tonnage forecasts were multiplied by the "without project" and "with project" condition required freight rates by alternative. This produces future transportation costs for each project alternative by vessel class and affected commodity tonnages for the "without" and "with project" condition. These "without" and "with project" condition transportation costs are presented in Tables B25 and B26 respectively, and represent the water leg portion of the transportation costs.

Lightering and transshipment costs for the "without" and "with project" conditions were developed applying the lightering and transshipment costs per ton (Table B23, and B24) to the tonnages lightered or transshipped under each alternative.

Table B25 - Transportation Costs Under "Without Project" Conditions by Commodity, by Harbor Segment, by Alternatives
(Tons and Dollars in 000's)

Commodity/Location	Vessel Class	1990	1995	2000	2010	2020	2030	2040
IRON ORE								
Traffic Forecast		768.6	772.7	776.8	785.1	793.4	801.8	810.3
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	10/5	$6,318.3	$6,351.7	$6,385.4	$6,453.2	$6,521.7	$6,590.9	$6,660.9
Lightering		274.0	275.5	276.9	279.9	282.8	285.8	288.9
Total		$6,592.3	$6,627.2	$6,662.3	$6,733.1	$6,804.5	$6,876.7	$6,949.8
Union Canal								
Traffic Forecast								
Domestic		107.6	123.6	141.9	187.2	246.9	325.6	429.4
Foreign		32.1	36.9	42.4	55.9	73.7	97.3	128.3
Total		139.7	160.5	184.3	243.1	320.6	422.9	557.7
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	5	$1,547.7	$1,777.4	$2,041.2	$2,692.0	$3,550.3	$4,682.4	$6,175.4
Foreign	7	54.6	62.7	72.0	95.0	125.3	165.3	218.0
Foreign	4	391.8	450.0	516.8	681.6	898.9	1,185.5	1,563.5
Lightering		66.6	76.5	87.8	115.7	152.7	201.4	261.2
Total		$2,060.7	$2,366.6	$2,717.8	$3,584.3	$4,727.2	$6,234.6	$8,218.0
Lackawanna Canal								
Traffic Forecast								
Domestic		1,286.6	1,350.2	1,417.9	1,560.6	1,718.7	1,892.9	2,084.8
Foreign		663.9	672.2	712.9	801.8	901.7	1,014.1	1,140.6
Total		1,920.5	2,022.4	2,129.9	2,362.4	2,620.4	2,907.0	3,225.4
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	10	$8,355.3	$8,768.5	$9,202.1	$10,134.7	$11,161.9	$12,293.2	$13,539.1
Domestic	8	1,386.1	1,454.7	1,526.6	1,681.3	1,851.7	2,039.4	2,246.1
Foreign	7	8,284.7	8,786.0	9,317.5	10,479.1	11,785.6	13,254.8	14,907.3
Total		$18,026.1	$19,009.2	$20,046.2	$22,295.1	$24,799.2	$27,587.4	$30,692.5
LIMESTONE								
Buffalo River								
Traffic Forecast		181.7	182.7	183.7	185.6	187.6	189.6	191.6
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	5	$1,068.5	$1,074.2	$1,079.9	$1,091.3	$1,102.9	$1,114.6	$1,126.5
Lightering		60.0	60.3	60.6	61.2	61.9	62.6	63.2
Total		$1,128.5	$1,134.5	$1,140.5	$1,152.5	$1,164.8	$1,177.2	$1,189.7
Union Canal								
Traffic Forecast		33.0	38.9	43.6	57.5	75.8	100.0	131.9
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	5	$199.6	$229.2	$263.2	$347.2	$457.9	$603.9	$796.4
Lightering		13.9	16.0	18.3	24.1	31.8	42.0	53.4
Total		$213.5	$245.2	$281.5	$371.3	$489.7	$645.9	$849.8
Lackawanna Canal								
Traffic Forecast		454.0	478.1	503.5	558.5	619.5	687.3	762.5
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	6	$3,269.0	$3,442.6	$3,625.5	$4,021.2	$4,460.6	$4,948.5	$5,490.3
GRAIN								
Buffalo River and Canal								
Traffic Forecast		1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4
Alternatives IId, IIe								
Transportation Costs								
Domestic	5	$16,170.4	$16,170.4	$16,170.4	$16,170.4	$16,170.4	$16,170.4	$16,170.4
SAND AND GRAVEL								
Buffalo Ship Canal								
Traffic Forecast		235.9	235.9	235.9	235.9	235.9	235.9	235.9
Alternatives IId, IIe,								
Transportation Costs								
Domestic	5	$2,403.4	$2,403.4	$2,403.4	$2,403.4	$2,403.4	$2,403.4	$2,403.4
Lakefront								
Traffic Forecast		68.9	68.9	68.9	68.9	68.9	68.9	68.9
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	7	$742.9	$742.9	$742.9	$742.9	$742.9	$742.9	$742.9

Table B26 - Transportation Costs Under "With Project" Conditions by Commodity by Harbor Segment, by Alternative
(Tons and Dollars in 000's)

Commodity/Location	Vessel Class	1990	1995	2000	2010		2030	2040
IRON ORE								
Buffalo River								
Tonnage Forecast								
Domestic		768.6	772.7	776.8	785.1	793.4	801.8	810.3
Alternatives IIe, IVa								
Transportation Costs								
Domestic	10/5	$6,095.4	$6,127.6	$6,160.1	$6,225.5	$6,291.6	$6,358.4	$6,425.9
Lightering		405.1	407.2	409.4	413.7	418.1	422.6	427.0
Total		$6,500.5	$6,534.8	$6,569.5	$6,639.2	$6,709.7	$6,781.0	$6,852.9
Alternatives IIIf, IIIi, Transshipment by Shuttle								
Transportation Costs								
Domestic	10	$4,803.8	$4,829.4	$4,855.0	$4,906.3	$4,958.8	$5,011.3	$5,064.4
Transshipment		807.0	811.3	815.6	824.3	833.1	841.9	850.8
Total		$5,610.8	$5,640.7	$5,670.6	$5,730.6	$5,791.9	$5,853.2	$5,915.2
Alternative IIIg, Transshipment by Rail from NFTA								
Transportation Costs								
Domestic	10	$4,803.8	$4,829.4	$4,855.0	$4,906.3	$4,958.8	$5,011.3	$5,064.4
Transshipment		960.8	888.6	893.3	863.5	753.7	721.6	648.2
Total		$5,764.6	$5,718.0	$5,748.3	$5,769.8	$5,712.5	$5,132.9	$5,712.6
Alternative IIIh, Transshipment by Rail from Independent Cement								
Transportation Costs								
Domestic	10	$4,803.8	$4,829.4	$4,855.0	$4,906.3	$4,958.8	$5,011.3	$5,064.4
Transshipment		960.8	888.6	854.5	824.3	753.7	681.5	648.2
Total		$5,764.6	$5,718.0	$5,709.5	$5,730.6	$5,712.5	$5,692.8	$5,712.6
Alternative IVb								
Transportation Costs								
Domestic	10/5	$6,172.2	$6,20[illegible].9	$6,237.8	$6,304.0	$6,370.9	$6,438.6	$6,507.0
Lightering		357.4	359.3	361.2	365.1	368.9	372.8	376.8
Total		$6,529.6	$6,564.2	$6,599.0	$6,669.1	$6,739.8	$6,811.4	$6,883.8
Union Canal								
Tonnage Forecast								
Domestic		107.6	123.6	141.9	187.2	246.9	325.6	429.4
Foreign		32.1	36.9	42.3	55.9	73.7	97.3	128.3
Total		139.7	160.5	184.3	243.1	320.6	422.9	557.7
Alternatives IIe, IVa								
Transportation Costs								
Domestic	5	$1,348.6	$1,548.7	$1,778.6	$2,345.7	$3,093.6	$4,080.0	$5,380.9
Foreign	7	46.3	53.2	61.1	80.5	106.2	140.1	184.8
Foreign	4	356.6	409.5	470.3	620.3	818.1	1,078.9	1,422.9
Lightering		90.	103.4	118.7	156.6	206.5	262.6	346.3
Total		$1,841.5	$2,114.8	$2,428.7	$3,203.1	$4,224.4	$5,561.6	$7,334.9
Alternatives IIIf, IIIi, Shuttle Vessel Transshipment								
Transportation Costs								
Domestic (1)	10	$873.8	$1,003.1	$1,151.9	$1,519.4	$2,003.8	$2,643.1	$3,485.6
Transshipment		104.9	120.4	138.2	182.3	240.5	317.2	418.3
Total		$978.7	$1,123.5	$1,290.1	$1,701.7	$2,244.3	$2,960.3	$3,903.9
Alternative IIIg, Rail Transshipment from NFTA								
Transportation Costs								
Domestic (1)	10	$873.8	$1,003.1	$1,151.9	$1,519.4	$2,003.8	$2,643.1	$3,485.6
Transshipment		146.8	160.5	184.3	230.9	272.5	338.3	390.4
Total		$1,020.6	$1,163.6	$1,336.2	$1,750.3	$2,276.3	$2,981.4	$3,876.0
Alternative IIIh, Rail Transshipment from Independent Cement								
Transportation Costs								
Domestic (1)	10	$873.8	$1,003.1	$1,151.9	$1,519.4	$2,003.8	$2,643.1	$3,485.6
Transshipment		139.8	160.5	175.1	218.8	272.5	317.2	390.4
Total		$1,013.6	$1,163.6	$1,327.0	$1,738.2	$2,276.3	$2,960.3	$3,876.0
Alternative IVb, Lightering at NFTA								
Transportation Costs								
Domestic	5	$1,434.7	$1,647.6	$1,892.1	$2,495.4	$3,291.1	$4,340.5	$5,724.5
Foreign	7	49.1	56.4	64.8	85.5	112.7	148.7	196.1
Foreign	4	367.5	422.1	484.7	639.2	843.1	1,111.9	1,466.4
Lightering		83.0	95.3	109.4	144.3	190.3	251.0	320.7
Total		$1,934.3	$2,221.4	$2,551.0	$3,364.4	$4,437.2	$5,852.1	$7,707.7

(1) Transshipment Alternatives assume that iron ore destined for the Union Canal will come from domestic sources only.

Table B26 - Transportation Costs Under "With Project" Conditions by Commodity by Harbor Segment, by Alternative (Cont'd)
(Tons and Dollars in 000's)

Commodity/Location	Vessel Class	1990	1995	2000	2010	2020	2030	2040
IRON ORE								
Lackawanna Canal								
Tonnage Forecast								
Domestic		1,286.6	1,350.2	1,417.0	1,560.6	1,718.7	1,892.9	2,084.8
Foreign		633.9	672.2	712.9	801.8	901.7	1,014.1	1,140.6
Total		1,920.5	2,022.4	2,129.9	2,362.4	2,620.4	2,907.0	3,225.4
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	10	$7,212.8	$7,569.4	$7,943.8	$8,748.9	$9,635.6	$10,612.2	$11,687.8
Domestic	8	1,182.0	1,240.5	1,301.8	1,433.8	1,579.1	1,739.1	1,915.4
Foreign	7	6,833.1	7,246.6	7 685.0	8,643.1	9,720.6	10,932.5	12,295.4
Total		$15,227.9	$16,056.5	$16,930.6	$18,825.8	$20,935.3	$23,283.8	$25,898.6
LIMESTONE								
Buffalo River								
Tonnage Forecast		181.7	182.7	183.7	185.6	187.6	189.6	191.6
Alternatives IIe, IIIf, IIIg, IVa, Lightering at NFTA								
Transportation Costs								
Domestic	5	$ 948.6	$ 953.6	$ 958.7	$ 968.8	$ 979.1	$ 989.5	$1,000.0
Lightering		90.0	90.4	90.9	91.9	92.8	93.8	94.8
Total		$1,038.6	$1,044.0	$1,049.6	$1,060.7	$1,071.9	$1,083.3	$1,094.8
Alterntives IIIh, IIIi, Lightering at Independent Cement								
Transportation Costs								
Domestic	5	$ 948.6	$ 953.6	$ 958.7	$ 968.8	$ 979.1	$ 989.5	$1,000.0
Lightering		110.9	111.5	112.1	113.3	114.5	115.7	117.0
Total		$1,059.5	$1,065.1	$1,070.8	$1,082.1	$1,093.6	$1,105.2	$1,117.0
Alternative IVb, Lightering at NFTA								
Transportation Costs:								
Domestic	5	$1,003.1	$1,008.4	$1,013.8	$1,024.5	$1,035.4	$1,046.4	$1,057.5
Lightering		79.1	79.5	79.9	80.7	81.6	82.5	83.3
Total		$1,082.2	$1,087.9	$1,093.7	$1,105.2	$1,117.0	$1,128.9	$1,140.8
Union Canal								
Tonnage Forecast		33.0	38.0	43.6	57.5	75.8	100.0	131.9
Alternatives IIe, IIIf, IIIg, IVa, Lightering at NFTA								
Transportation Costs								
Domestic	5	$174.8	$200.8	$230.6	$304.1	$401.0	$528.9	$697.5
Lightering		18.8	21.6	24.8	32.8	43.2	57.0	75.2
Total		$193.6	$222.4	$255.4	$336.9	$444.2	$585.9	$772.7
Alterntives IIIh, IIIi, Lightering at Independent Cement								
Transportation Costs								
Domestic	5	$174.8	$200.8	$230.6	$304.1	$401.0	$528.9	$697.5
Lightering		13.8	15.9	18.2	24.0	31.7	41.8	55.1
Total		$188.6	$216.7	$248.8	$328.1	$432.7	$570.7	$752.6
Alternative IVb, Lightering at NFTA								
Transportation Costs								
Domestic	5	$184.7	$212.1	$243.6	$321.3	$432.8	$558.9	$737.1
Lightering		17.3	19.9	22.9	30.2	39.8	52.5	69.2
Total		$202.0	$232.0	$266.5	$351.5	$463.6	$611.4	$806.3
Lackawanna Canal								
Tonnage Forecast		454.0	478.1	503.5	558.5	619.5	687.3	762.5
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	6	$2,869.5	$3,021.8	$3,182.4	$3,529.7	$3,915.4	$4,343.7	$4,819.2
GRAIN								
Buffalo River and Canal								
Tonnage Forecast		1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4
Alternatives IId, IIe								
Transportation Costs								
Domestic	5	$14,579.4	$14,579.4	$14,579.4	$14,579.4	$14,579.4	$14,579.4	$14,579.4
SAND AND GRAVEL								
Buffalo Ship Canal								
Tonnage Forecast		235.9	235.9	235.9	235.9	235.9	235.9	235.9
Alternatives IId, IIe - MOD = 22.5 feet								
Transportation Costs								
Domestic	5	$1,969.4	$1,969.4	$1,969.4	$1,969.4	$1,969.4	$1,969.4	$1,969.4
Outer Harbor								
Tonnage Forecast		68.9	68.9	68.9	68.9	68.9	68.9	68.9
Alternatives IIe, IIIf, IIIg, IVa - MOD = 25.5 feet								
Transportation Costs								
Domestic	7	$644.5	$644.5	$644.5	$644.5	$644.5	$644.5	$644.5
Alternatives IIIh, IIIi, IVb - MOD = 24.5 feet								
Transportation Costs:								
Domestic	7	$679.6	$679.6	$679.6	$679.6	$679.6	$679.6	$679.6

Finally the difference between the "without" and "with project" condition transportation costs (water leg and transshipment costs) were calculated and are presented in Table B27. The net transportation cost time streams by vessel class and commodity type for each alternative was converted to an average annual equivalent value and are presented in Table B27. The average annual equivalents are based upon a discount rate of 7.625 percent, a 50-year project life and normal growth between intervals. The net transportation cost time streams for the tonnages affected by each alternative will be discussed in more detail.

b. Alternative IId - Buffalo River And Ship Canal Improvements Via the North Entrance - Alternative IId is a north entrance improvement plan which includes deepening the harbor approach channels, the Buffalo River and the Buffalo Ship Canal to allow a maximum operating draft of 22.5 feet. The maximum operating draft in the "without project" condition on the river and ship canal is 19.5 feet. This plan would allow Class 5 vessels to transport grain to companies located on the Buffalo River and Ship Canal at a lower cost due to the increased operating draft. The costs of shipping sand and gravel to the Buffalo Ship Canal in Class 5 vessels would decrease for the same reason. The average annual transportation cost savings attributable to Alternative IId was $2,025,000 with grain benefits composing 79 percent of this total.

c. Alternative IIe - South Entrance Improvements - Alternative IIe is a south entrance improvement plan which involves breakwater improvements at the south entrance. This plan also includes deepening the Buffalo Ship Canal and a portion of the Buffalo River. The maximum operating draft on the Buffalo River and Ship Canal would increase from 19.5 feet to 22.5 feet. The south entrance channel and the Outer Harbor from the end to the Lackawanna Canal to the NFTA Pier would have a maximum operating draft of 25.5 feet.

The commodities affected by Alternative IIe are grain, sand and gravel, iron ore, and limestone. Average annual grain transportation costs on the River and Ship Canal decreased by $1,591,000 as a result of increased operating draft as compared to the base case. Costs of shipping sand and gravel are less due to the improved operating draft of 22.5 feet on the Ship Canal and 25.5 feet at the Lakefront. This resulted in average annual transportation cost savings for sand and gravel of $532,400.

Iron ore moving upriver and to the Union Canal incur decreased transportation costs as a result of greater operating drafts in the Outer Harbor which allows an increase of lightering activity at the NFTA docks. The decrease in iron ore average annual transportation costs due to increased lightering amounted to $422,500. Shipments of iron ore to the Lackawanna Canal saved $3,234,700 in average annual transportation costs due to the increased Outer Harbor maximum operating drafts.

Limestone moving upriver and to the Union Canal saved $120,900 in average annual transportation costs because of increased lightering activity at the NFTA docks. Limestone destined for the Lackawanna Canal saved $459,300 annually due to the greater Outer Harbor operating drafts provided by this Alternative. The total average annual transportation cost savings for this alternative came to $6,360,800.

d. Alternative IIIf - This plan involves breakwater improvements at the south entrance and deepening the south entrance channel and the Outer Harbor from the end of the Lackawanna Canal to the dock facilities at NFTA to a maximum operating draft of 25.5 feet. In addition, an iron ore shuttle vessel transshipment facility would be developed at NFTA.

Iron ore, limestone, and sand and gravel would be affected by this alternative. Iron ore destined for the Lackawanna Canal had a fall in average annual transportation costs of $3,234,700 due to the increased Outer Harbor operating draft this plan made available. Iron ore destined for the Buffalo River and Union Canal would use a shuttle system based at the NFTA docks. Iron ore for these two areas would be shipped in Class 10 vessels to the NFTA docks, discharged, and then transported by shuttle to their final destinations. Presently the iron ore destined for these two areas is transported in Class 7, 5, and 4 vessels which lighter at the NFTA docks before proceeding to their final destinations. The lightered tons are trucked upriver and to the Union Canal. The decrease in the water leg transportation cost from the use of Class 10 vessels offsets the increase in transshipment costs over lightered costs. Therefore the average annual transportation costs of iron ore destined for the Buffalo River and Union Canal decreased by $2,522,700.

Limestone transportation costs for the Bufalo River and Union Canal also decrease because the greater operating draft in the Outer Harbor at the NFTA docks allows more lightering activity. The increased lightering costs were more than offset by the decrease in the water leg transportation cost. Therefore limestone average annual transportation costs for these two areas decreased by $120,900. Average annual transportation costs of limestone destined for the Lackawanna Canal decreased by $459,300 because of the increased Outer Harbor maximum operating draft at the NFTA docks.

Class 7 vessels shipping sand and gravel to NFTA would have average annual transportation savings of $98,400 due to the increase in their present maximum operating draft of 22.5 feet to 25.5 feet. The total average annual transportation savings for Alternative IIIf is $6,531,800.

e. Alternative IIIg - Alternative IIIg involves the same south entrance breakwater improvements and Outer Harbor deepening improvements to a 25.5-foot MOD as Alternative IIIf. This plan also calls for a transshipment facility to be built at NFTA. However, the mode of transshipment for this plan is train instead of a shuttle vessel.

The same commodities are affected by Alternative IIIg as IIIf: Iron ore, limestone, and sand and gravel. Transportation savings for these commodities occur for the same reasons as described under Alternative IIIf, except that the mode of transshipment is train instead of a shuttle. Average annual transportation savings for all affected commodities were $6,436,000.

f. Alternative IIIh - Alternative IIIh involves improvements to the south entrance breakwaters and deepening of the south entrance channel and the southern portions of the Outer Harbor to a 25.5-foot maximum operating draft. Vessels operating in the Outer Harbor beyond the deepened portion of

the lakefront are subject to a maximum operating draft of 24.5 feet. This plan also includes an iron ore transshipment facility based at Independent Cement. All iron ore destined for the Buffalo River or Union Canal would use this transshipment facility.

The commodities affected under this plan are iron ore limestone, and sand and gravel. Iron ore delivered to the Lackawanna Canal had an average annual transportation savings of $3,234,700 due to increased vessel draft in the Outer Harbor. Iron ore shipped to the Buffalo River and Union Canal would use a train transshipment facility based at Independent Cement. Iron ore destined for these two areas would be shipped in Class 10 vessels to Independent Cement, discharged and then transported by train to their final destinations. The affects of this plan on upriver and Union Canal iron ore is the same as IIIg except that transshipments take place from Independent Cement and not from NFTA. The decrease in the water leg transportation cost from the use of Class 10 vessels offsets the increase in transshipment costs over lightered costs. The average annual transportation costs of Buffalo River and Union Canal iron ore decreased by $2,529,200.

Limestone transportation costs for the Buffalo River and Union Canal also decreased because the greater operating draft in the Outer Harbor allows more lightering activity to take place in the Outer Harbor. This lightering would take place at Independent Cement. Again the increased lightering costs were more than offset by the decrease in the transportation costs associated with the water leg. Therefore limestone average annual transportation costs for these two areas decreased by $107,100. Limestone average annual transportation costs destined for the Lackawanna Canal decreased by $459,300 because of the increased Outer Harbor maximum operating draft.

Class 7 vessels delivering sand and gravel to NFTA would have average annual transportation savings of $63,300 due to the increase in Outer Harbor maximum operating draft from 22.5 feet to 24.5 feet. The total average annual transportation savings for Alternative IIIh amount to $6,393,600.

g. Alternative IIIi - Alternative IIIi involves the same south entrance breakwater improvements and channel deepening improvements to allow a 25.5-foot maximum operating draft as Alternative IIIh. This plan also includes a shuttle iron ore transshipment facility based at Independent Cement.

The commodities affected by this plan are iron ore, limestone, and sand and gravel. Transportation savings for these commodities occur for the same reasons as described under Alternative IIIf except that the mode of transshipment is shuttle instead of rail. Average annual transportation savings for all affected commodities were $6,482,900.

h. Alternative IVa - Alternative IVa involves breakwater improvements at the south entrance along with channel deepening in the south entrance and in the Outer Harbor from the end of the Lackawanna Canal to the NFTA Seaway Pier that would result in a maximum operating draft of 25.5 feet.

The commodities affected by this alternative are iron ore, limestone, and sand and gravel. Upriver and Union Canal iron ore shipments would realize

decreased transportation costs due to the increased amount of lightering that would take place at NFTA. Lightering would increase due to the greater operating drafts available in the Outer Harbor in the "with project" conditon. Average annual iron ore transportation costs for these two areas would decrease by $422,500. Iron ore destined for the Lackawanna Canal realized average annual transportation savings of $3,234,700 as a result of Outer Harbor operating drafts rising from 22.5 feet to 25.5 feet.

Buffalo River and Union Canal Limestone transportation costs also decreased because of increased lightering at NFTA due to increased Outer Harbor operating drafts. Again the increased lightering costs were more than offset by the decrease in the transportation costs associated with the water leg. Limestone average annual transportation costs for these two areas decreased by $120,900. Average annual transportation costs for Lackawanna Limestone decreased by $459,300.

Also, Class 7 vessels delivering sand and gravel to NFTA would have average annual transportation savings of $98,400 due to the increase in Outer Harbor maximum operating draft from 22.5 feet to 25.5 feet. The total average annual transportation savings for Alternative IVa amounts to $4,335,800.

i. Alternative IVb - Alternative IVb involves breakwater improvements at the south entrance along with channel deepening in the south entrance and in the Outer Harbor from the end of the Lackawanna Canal to 2,000 feet northwest of the south breakwaters north side light that would allow a maximum operating draft of 25.5 feet. Vessels operating on the lakefront beyond the deepened area are subject to a maximum operating draft of 24.5 feet.

The commodities affected by this alternative are iron ore, limestone, and sand and gravel. Vessels carrying iron ore upriver and to the Union Canal would increase their lightering operations at NFTA to take advantage of the 24.5-foot maximum operating draft available due to south entrance improvements. Iron ore average annual transportation costs for these two areas decreased by $253,200. Iron ore vessels destined for the Lackawanna Canal would have 25.5 feet of draft and would have average annual transportation cost savings of $3,234,700.

Limestone destined for the Buffalo River and Union Canal would also increase their lightering activity. There would be a 24.5-foot maximum operating draft available at the NFTA docks because of improvements to the south entrance channnel. Limestone average annual transportation savings for these two areas totaled $64,100. Average Annual transportation costs for Lackawanna limestone decreased by $459,300.

Also average annual transportation costs for sand and gravel shipped to NFTA would decrease by $63,300 due to the increase in maximum operating draft at NFTA from 22.5 to 24.5 for Class 7 vessels. The average annual transportation savings for all affected commodities was $4,074,600.

Table B27 - Transportation Savings by Alternative
(Dollars in 000's)

Commodity/Location	Net Transportation Savings 1990	1995	2000	2010	2020	2030	2040	Average Annual Equivalents
	$	$	$	$	$	$	$	
Alternative IId - North Entrance With MOD of 22.5 feet on the Buffalo River and Ship Canal								
GRAIN								
Buffalo River and Canal	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0
SAND AND GRAVEL								
Buffalo Ship Canal	434.0	434.0	434.0	434.0	434.0	434.0	434.0	434.0
Total Transportation Savings	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0
Alternative IIe - South Entrance With MOD of 25.5 feet in the Outer Harbor and 22.5 Feet MOD on the Buffalo River and Ship Canal								
GRAIN								
Buffalo River and Canal	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0
SAND AND GRAVEL								
Buffalo Ship Canal	434.0	434.0	434.0	434.0	434.0	434.0	434.0	434.0
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Subtotal	532.4	532.4	532.4	532.4	532.4	532.4	532.4	532.4
IRON ORE								
Buffalo River	91.8	92.4	92.8	93.9	94.8	95.7	96.9	93.1
Union Canal	219.2	251.8	289.1	381.2	502.8	673.0	883.1	329.4
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	3,109.2	3,296.9	3,497.5	3,944.4	4,461.5	5,072.3	5,773.9	3,657.2
LIMESTONE								
Buffalo River	89.9	90.5	90.9	91.8	92.9	93.9	94.9	91.2
Union Canal	19.9	22.8	26.1	34.4	45.5	60.0	77.1	29.7
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	509.3	534.1	560.1	617.7	683.6	758.7	843.1	580.2
Total Transportation Savings	5,741.9	5,954.4	6,181.0	6,685.5	7,268.5	7,954.4	8,740.4	6,360.8

Table B27 - Transportation Savings by Alternative (Cont'd)
(Dollars in 000's)

Commodity/Location	Net Transportation Savings 1990	1995	2000	2010	2020	2030	2040	Average Annual Equivalents
	$	$	$	$	$	$	$	
Alternative IIIf - Transshipment by Shuttle from NFTA With a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	981.5	986.5	991.7	1,002.5	1,012.6	1,023.5	1,034.6	994.8
Union Canal	1,082.0	1,243.1	1,427.7	1,882.6	2,482.9	3,274.3	4 314.1	1,623.7
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	4,861.7	5,182.3	5,535.0	6,354.4	7,359.4	8,601.4	10,142.6	5,853.2
LIMESTONE								
Buffalo River	89.9	90.5	90.9	91.8	92.9	93.9	94.9	91.2
Union Canal	19.9	22.8	26.1	34.4	45.5	60.0	77.1	29.7
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	509.3	534.1	560.1	617.7	683.6	758.7	843.1	580.2
SAND AND GRAVEL								
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Total Transportation Savings	5,469.4	5,814.8	6,193.5	7,070.5	8,141.4	9,458.5	11,084.1	6,531.8
Alternative IIIg - Transshipment by Rail from NFTA With a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	827.7	909.2	914.0	963.3	1,092.0	1,143.8	1,237.2	940.3
Union Canal	1,040.1	1,203.0	1,381.6	1,834.0	2,450.9	3,253.2	4,342.0	1,582.4
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	4,666.0	5,064.9	5,411.2	6,266.6	7,406.8	8,700.6	10,373.1	5,757.4
LIMESTONE								
Buffalo River	89.9	90.5	90.9	91.8	92.9	93.9	94.9	91.2
Union Canal	19.9	22.8	26.1	34.4	45.5	60.0	77.1	29.7
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	509.3	534.1	560.1	617.7	683.6	758.7	843.1	580.2
SAND AND GRAVEL								
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Total Transportation Savings	5,273.7	5,697.4	6,069.7	6,982.7	8,188.8	9,557.7	11,314.6	6,436.0

Table B27 - Transportation Savings by Alternative (Cont'd)
(Dollars in 000's)

Commodity/Location	Net Transportation Savings 1990	1995	2000	2010	2020	2030	2040	Average Annual Equivalents
	$	$	$	$	$	$	$	
Alternative IIIh - Transshipment by Rail From Independent Cement With A MOD of 25.5 Feet								
IRON ORE								
Buffalo River	827.7	909.2	952.8	1,002.5	1,092.0	1,183.9	1,237.2	940.3
Union Canal	1,047.1	1,203.0	1,390.8	1,846.1	2,450.9	3,274.3	4,342.0	1,588.9
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	4,673.0	5,064.9	5,459.2	6,317.9	7,406.8	8,761.8	10,373.1	5,763.9
LIMESTONE								
Buffalo River	69.0	69.4	69.7	70.4	71.2	72.0	72.7	69.9
Union Canal	24.9	28.5	32.7	43.2	57.0	75.2	97.2	37.2
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	493.4	518.7	545.5	605.1	673.4	752.0	841.0	566.4
SAND AND GRAVEL								
Outer Harbor	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
Total Transportation Savings	5,229.7	5,646.9	6,068.0	6,986.3	8,143.5	9,577.1	11,277.4	6,393.6
Alternative IIIi - Transshipment by Shuttle from Independent Cement With a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	981.5	986.5	991.7	1,002.5	1,012.6	1,023.5	1,034.6	994.8
Union Canal	1,082.0	1,243.1	1,427.7	1,882.6	2,482.9	3,274.3	4,314.1	1,623.7
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	4,861.7	5,182.3	5,535.0	6,354.4	7,359.4	8,601.4	10,142.6	5,853.2
LIMESTONE								
Buffalo River	69.0	69.4	69.7	70.4	71.2	72.0	72.7	69.9
Union Canal	24.9	28.5	32.7	43.2	57.0	75.2	97.2	37.2
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	493.4	518.7	545.5	605.1	673.4	752.0	841.0	566.4
SAND AND GRAVEL								
Outer Harbor	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
Total Transportation Savings	5,418.4	5,764.3	6,143.8	7,022.8	8,096.1	9,416.7	11,046.9	6,482.9

Table B27 - Transportation Savings by Alternative (Cont'd)
(Dollars in 000's)

Commodity/Location	Net Transportation Savings 1990	1995	2000	2010	2020	2030	2040	Average Annual Equivalents
	$	$	$	$	$	$	$	
Alternative IVa - South Entrance Improvement With a MOD of 25.5 Feet to the NFTA Seaway Piers								
IRON ORE								
Buffalo River	91.8	92.4	92.8	93.9	94.8	95.7	96.9	93.1
Union Canal	219.2	251.8	289.1	381.2	502.8	673.0	883.1	329.4
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	3,109.2	3,296.9	3,497.5	3,944.4	4,461.5	5,072.3	5,773.9	3,657.2
LIMESTONE								
Buffalo River	89.9	90.5	90.9	91.8	92.9	93.9	94.9	91.2
Union Canal	19.9	22.8	26.1	34.4	45.5	60.0	77.1	29.7
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	509.3	534.1	560.1	617.7	683.6	758.7	843.1	580.2
SAND AND GRAVEL								
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Total Transportation Savings	3,716.9	3,929.4	4,156.0	4,660.5	5,243.5	5,929.4	6,715.4	4,335.8
Alternative IVb - South Entrance Improvement With a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	62.7	63.0	63.3	64.0	64.7	65.3	66.0	63.5
Union Canal	126.4	145.2	166.8	219.9	290.0	382.5	510.3	189.7
Lackawanna Canal	2,798.2	2,952.7	3,115.6	3,469.3	3,863.9	4,303.6	4,793.9	3,234.7
Subtotal	2,987.3	3,160.9	3,345.7	3,753.2	4,218.6	4,751.4	5,370.2	3,487.9
LIMESTONE								
Buffalo River	46.3	46.6	46.8	47.3	47.8	48.3	48.9	47.0
Union Canal	11.5	13.2	15.0	19.8	26.1	34.5	43.5	17.1
Lackawanna Canal	399.5	420.8	443.1	491.5	545.2	604.8	671.1	459.3
Subtotal	457.3	480.6	504.9	558.6	619.1	687.6	763.5	523.4
SAND AND GRAVEL								
Outer Harbor	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
Total Transportation Savings	3,507.9	3,704.8	3,913.9	4,375.1	4,901.0	5,502.3	6,197.0	4,074.6

B6 SENSITIVITY EVALUATION - TRANSPORTATION COSTS

a. Low Growth Scenario - Correspondence and interviews with the Buffalo Harbor iron ore users indicated that a future scenario of lower iron ore tonnages than those presented in Table B18 could be constructed. Therefore alternate projections were made, based on maximum tonnage levels stated in their correspondence and interviews. These maximum tonnages were used as the value for project year 2040. Tonnage levels between 1980 and 2040 were interpolated. Limestone projections were again assumed to be a given percentage of iron ore needs based upon historical data for the time period 1976-1980. The grain, and sand and gravel projections are assumed to remain unchanged. The commodity projections for this low-growth scenario are presented in Table B28.

The lightering and transshipment costs associated with the lower tonnage projections were calculated and are presented in Tables B29 and B30 respectively. These lightering and transshipment costs per ton were used in conjunction with the required freight rates presented in Tables B21 and B22 to determine transportation costs in the "without" and "with project" condition by alternative. The forecasted tonnages of Table B28 were distributed over a range of ship sizes applicable to each alternative for the "without" and "with project" condition (Tables B15 and B16). The applicable "without" and "with project" conditions required freight rates (Tables B21 and B22) were applied to the tonnages expected to be carried by vessel class to determine the water leg of the transportation costs. Lightering and transshipment costs for the "without" and "with project" conditions were developed by applying the lightering and transshipment costs per ton (Table B29 and B30) to the tonnages lightered or transshipped under each alternative. The "without" and "with project" transportation costs for Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, and IVb are presented in Tables B31 and B32 respectively. The difference between the "without" and "with project" condition transportation costs by alternative were calculated and are presented in Table B33. Each net transportation cost time stream by vessel class and commodity type for each alternative was converted to an average annual equivalent and are presented in Table B33. These average annual equivalent transportation costs will be used as a proxy for transportation benefits associated with the implementation of the alternatives.

Table B28 - Projected Commodity Tonnages - Buffalo Harbor Sensitivity Analysis
(Tons in 000's)

Commodity/ Geographic Area	Project Year 1990	1995	2000	2010	2020	2030	2040
Grain - Alternatives IId, IIe							
Buffalo Harbor	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4
Iron Ore - Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb							
Buffalo River							
Domestic	413.7	431.4	450.0	489.5	522.4	579.2	600.0
Union Canal							
Domestic	106.5	121.7	139.1	181.6	237.1	309.6	358.1
Foreign	31.8	36.4	41.6	54.3	70.8	92.5	107.0
Total	138.3	158.1	180.7	235.9	307.9	402.1	465.0
Lackawanna Canal							
Domestic	1,198.3	1,236.3	1,275.6	1,357.9	1,445.5	1,538.7	1,638.0
Foreign	645.2	665.7	686.8	731.2	778.3	828.5	882.0
Total	1,843.5	1,902.0	1,962.4	2,089.1	2,223.8	2,367.2	2,520.0
Limestone - Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb							
Buffalo River							
Domestic	97.8	102.0	106.4	115.7	125.9	136.9	141.9
Union Canal							
Domestic	32.7	37.4	42.7	55.8	72.8	95.1	124.1
Lackawanna Canal							
Domestic	435.8	449.7	464.0	493.9	525.8	559.7	595.8
Sand and Gravel							
Buffalo Ship Canal - Alternatives IId, IIe							
Domestic	235.9	235.9	235.9	235.9	235.9	235.9	235.9
Outer Harbor - Alternatives IIe, IIf, IIIg, IIIh, IIIi, IVa, IVb							
Domestic	68.9	68.9	68.9	68.9	68.9	68.9	68.9

Table B29 - Lightering Costs per Ton - Iron Ore and Limestone - Sensitivity Analysis

Commodity/Location	Cost Per Ton In Dollars						
	1990	1995	2000	2010	2020	2030	2040
<u>Without Project Lightering Costs</u>							
Iron Ore IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb							
Buffalo River	1.65	1.65	1.65	1.65	1.65	1.65	1.65
Union Canal							
Domestic	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Foreign	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Limestone IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb							
Buffalo River	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Union Canal	1.50	1.50	1.50	1.50	1.50	1.50	1.50
<u>With-Project Lightering Costs</u>							
Iron Ore IIe, IVa							
Buffalo River	1.65	1.65	1.65	1.65	1.60	1.60	1.60
Union Canal							
Domestic	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Foreign	1.55	1.55	1.55	1.55	1.55	1.55	1.55
Iron Ore IVb							
Buffalo River	1.65	1.65	1.65	1.65	1.65	1.60	1.60
Union Canal							
Domestic	1.60	1.60	1.60	1.60	1.60	1.60	1.60
Foreign	1.55	1.55	1.55	1.55	1.55	1.55	1,55
Limestone IIe, IIIf, IIIg, IVa							
Buffalo River	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Union Canal	1.50	1.50	1.50	1.50	1.50	1.50	1.50
Limestone IIIh, IIIi							
Buffalo River	1.85	1.85	1.85	1.85	1.85	1.85	1.85
Union Canal	1.10	1.10	1.10	1.10	1.10	1.10	1.10

Table B30 - Transshipment Costs - Iron Ore Sensitivity Analysis

Commodity 1 Mode of Transshipment	Cost Per Ton in Dollars						
	1990	1995	2000	2010	2020	2030	2040
IRON ORE							
Shuttle Vessel - IIIf, NFTA							
Buffalo River	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Union Canal	.75	.75	.75	.75	.75	.75	.75
Rail - IIIg - NFTA							
Buffalo River	1.65	1.70	1.60	1.45	1.20	1.10	1.00
Union Canal	1.65	1.55	1.45	1.30	1.10	1.00	.90
IRON ORE							
Rail IIIh - Independent Cement							
Buffalo River	1.80	1.70	1.60	1.40	1.20	1.05	1.00
Union Canal	1.65	1.55	1.45	1.25	1.10	.95	.90
Shuttle Vessel IIIi - Independent Cement							
Buffalo River	1.05	1.05	1.05	1.05	1.05	1.05	1.05
Union Canal	.75	.75	.75	.75	.75	.75	.75

Table B31 - Transportation Costs Under "Without Project" Conditions by Commodity, by Harbor Segment, by Alternatives - *Sensitivity Analysis* (Tons and Dollars in 000's)

Commodity/Location	Vessel Class	1990	1995	2000	2010	2020	2030	2040
IRON ORE								
Buffalo River								
Traffic Forecast		413.7	431.4	450.0	489.5	532.4	579.2	600.0
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	10/5	$3,400.3	$3,546.4	$3,698.8	$4,023.4	$4,376.6	$4,760.7	$4,932.0
Lightering		157.0	163.7	170.8	185.8	202.1	219.8	227.7
Total		$3,557.3	$3,710.1	$3,869.6	$4,209.2	$4,578.7	$4,980.5	$5,159.7
Union Canal								
Traffic Forecast								
Domestic		106.5	121.7	139.1	181.6	237.1	309.6	358.1
Foreign		31.8	36.4	41.6	54.3	70.8	92.5	107.0
Total		138.3	158.1	180.7	235.9	307.9	402.1	465.1
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	5	$1,532.2	$1,750.7	$2,000.4	$2,611.9	$3,410.1	$4,452.3	$5,148.8
Foreign	7	54.1	61.8	70.6	92.2	120.4	157.1	181.7
Foreign	4	387.9	443.3	506.5	661.3	863.4	1,127.3	1,303.6
Lightering		67.6	77.3	88.3	115.3	150.5	196.5	227.3
Total		$2,041.8	$2,333.1	$2,665.8	$3,480.7	$4,544.4	$5,933.2	$6,861.4
Lackawanna Canal								
Traffic Forecast								
Domestic		1,198.3	1,236.3	1,275.6	1,357.9	1,445.5	1,538.7	1,638.0
Foreign		645.2	665.7	686.8	731.2	778.3	828.5	882.0
Total		1,843.5	1,902.0	1,962.4	2,089.1	2,223.8	2,367.2	2,520.0
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	10	$7,781.9	$8,029.0	$8,284.0	$ 8,818.4	$ 9,387.3	$ 9,992.9	$10,637.6
Domestic	8	1,291.0	1,332.0	1,374.3	1,462.9	1,557.3	1,657.8	1,764.7
Foreign	7	8,433.1	8,700.8	8,977.1	9,556.3	10,170.6	10,829.1	11,527.7
Total		$17,506.0	$18,061.8	$18,635.4	$19,837.6	$21,115.2	$22,479.8	$23,930.0
LIMESTONE								
Buffalo River								
Traffic Forecast		97.8	102.0	106.4	115.7	125.9	136.9	141.9
Alternatives IIe, IIIf, IIIg, IIIh, IIIg, IIIi, IVa, IVb								
Transportation Costs								
Domestic	5	$ 575.1	$ 599.7	$ 625.5	$ 680.4	$ 740.2	$ 805.1	$ 834.1
Lightering		32.3	33.7	35.1	38.2	41.5	45.2	46.8
Total		$ 607.4	$ 633.4	$ 660.6	$ 718.6	$ 781.7	$ 850.3	$ 880.9
Union Canal								
Traffic Forecast		32.7	37.4	42.7	55.8	72.8	95.1	124.1
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	5	$197.6	$225.8	$258.0	$336.8	$439.8	$574.2	$749.7
Lightering		13.7	15.7	17.9	23.4	30.6	39.9	52.1
Total		$211.3	$241.5	$275.9	$360.2	$470.4	$614.1	$801.8
Lackawanna Canal								
Traffic Forecast		435.8	449.7	464.0	493.9	525.8	559.7	595.8
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domistic	6	$3,138.0	$3,237.7	$3,340.5	$3,556.0	$3,785.4	$4,029.6	$4,289.6
GRAIN								
Buffalo River and Canal								
Traffic Forecast		1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4
Alternatives IId, IIe								
Transportation Costs								
Domestic	5	$16,170.4	$16,170.4	$16,170.4	$16,170.4	$16,170.4	$16,170.4	$16,170.4
SAND AND GRAVEL								
Buffalo Ship Canal								
Traffic Forecast		235.9	235.9	235.9	235.9	235.9	235.9	235.9
Alternatives IId, IIe								
Transportation Costs								
Domestic	5	$2,403.4	$2,403.4	$2,403.4	$2,403.4	$2,403.4	$2,403.40	$2,403.4
Lakefront								
Traffic Forecast		68.9	68.9	68.9	68.9	68.9	68.9	68.9
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	7	$742.9	$742.9	$742.9	$742.9	$742.9	$742.9	$742.9

Table B32 - Transportation Costs Under 'With Project' Conditions by Commodity, by Harbor Segment, by Alternatives - Sensitivity Analysis (Tons and Dollars in 000's)

Commodity/Location	Vessel Class	1990	1995	2000	2010	2020	2030	2040
IRON ORE								
Lackawanna Canal								
Tonnage Forecast								
Domestic		1,198.3	1,236.3	1,275.6	1,357.9	1,445.5	1,538.7	1,638.0
Foreign		645.2	665.7	686.8	731.0	778.3	828.5	882.0
Total		1,843.5	1,902.0	1,962.4	2,089.0	2,223.8	2,367.2	2,520.0
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	10	$6,717.8	$6,931.1	$7,151.2	$7,612.6	$8,103.7	$8,626.5	$9,183.0
Domestic	8	1,100.9	1,135.9	1,171.9	1,247.6	1,328.0	1,413.7	1,504.9
Foreign	7	6,955.5	7,176.4	7,402.2	7,881.9	8,388.6	8,931.7	9,508.0
Total		$14,774.2	$15,243.4	$15,725.3	$16,742.1	$17,820.3	$18,971.9	$20,195.9
Buffalo River								
Tonnage Forecast								
Domestic		413.7	431.4	450.0	489.5	532.4	579.2	600.0
Alternatives IIe, IVa								
Transportation Costs								
Domestic	10/5	$3,280.4	$3,421.3	$3,568.3	$3,881.5	$4,222.2	$4,592.8	$4,758.0
Lightering		232.1	242.0	252.4	274.6	289.6	315.1	326.4
Total		$3,512.5	$3,663.3	$3,820.7	$4,156.1	$4,511.8	$4,907.9	$5,084.4
Alternatives IIIf, IIIi, Transshipment by Shuttle								
Transportation Costs								
Domestic	10	$2,585.6	$2,696.3	$2,812.5	$3,059.4	$3,327.5	$3,620.0	$3,750.0
Transshipment		434.4	453.0	472.5	514.0	559.0	608.2	630.0
Total		$3,020.0	$3,149.3	$3,285.0	$3,573.4	$3,886.5	$4,228.2	$4,380.0
Alternatives IIIg, Transshipment by Rail from NFTA								
Transportation Costs								
Domestic	10	$2,585.6	$2,696.3	$2,812.5	$3,059.4	$3,327.5	$3,620.0	$3,750.0
Transshipment		744.7	733.4	724.5	704.9	649.5	625.5	606.0
Total		$3,330.3	$3,429.7	$3,537.0	$3,764.3	$3,977.0	$4,245.5	$4,356.0
Alternatives IIIh, Transhipment by Rail from Independent Cement								
Transportation Costs								
Domestic	10	$2,585.5	$2,696.3	$2,812.5	$3,059.4	$3,327.5	$3,620.0	$3,750.0
Transshipment		736.4	724.8	711.0	695.1	644.2	614.0	600.0
Total		$3,322.0	$3,421.1	$3,523.5	$3,754.5	$3,971.7	$4,234.0	$4,350.0
Alternative IVb								
Transportation Costs								
Domestic	10/5	$3,321.7	$3,464.4	$3,613.3	$3,930.4	$4,275.4	$4,650.7	$4,818.0
Lightering		204.8	213.6	222.7	242.3	263.6	269.3	279.0
Total		$3,526.5	$3,678.0	$3,836.0	$4,172.7	$4,539.0	$4,920.0	$5,097.0
Union Canal								
Tonnage Forecast								
Domestic		106.5	121.7	139.1	181.6	237.1	309.	358.1
Foreign		31.8	36.4	41.6	54.3	70.8	92.5	107.0
Total		138.3	158.1	180.7	235.9	307.9	402.1	465.1
Alternatives IIe, IVa								
Transportation Costs								
Domestic	5	$1,335.1	$1,525.5	$1,743.1	$2,275.8	$2,971.4	$3,879.5	$4,486.4
Foreign	7	45.8	52.4	59.9	78.1	102.0	133.2	154.1
Foreign	4	353.0	403.4	460.9	601.8	785.7	1,025.9	1,186.3
Lightering		88.8	101.5	115.9	151.4	197.6	258.0	298.4
Total		$1,822.7	$2,082.8	$2,379.8	$3,107.1	$4,056.7	$5,296.6	$6,125.2
Alternatives IIIf, IIIi, Shuttle Vessel Transshipment								
Transportation Costs								
Domestic (1)	10	$865.0	$ 988.1	$1,129.4	$1,474.4	$1,925.0	$2,513.1	$2,906.3
Transshipment		103.8	118.6	135.6	176.9	231.0	301.6	348.8
Total		$ 968.8	$1,106.7	$1,265.0	$1,651.3	$2,156.0	$2,814.7	$3,255.1
Alternative IIIg, Rail Transshipment from NFTA								
Transportation Costs								
Domestic (1)	10	$865.0	$ 988.1	$1,129.4	$1,474.4	$1,925.0	$2,513.1	$2,906.3
Transshipment		228.4	245.1	263.8	304.3	345.0	394.1	423.2
Total		$1,093.4	$1,233.2	$1,393.2	$1,778.7	$2,270.0	$2,907.2	$3,329.5
Alternative IIIh, Rail Transshipment from Independent Cement								
Transportation Costs								
Domestic (1)	10	$865.0	$ 988.1	$1,129.4	$1,474.4	$1,925.0	$2,513.1	$2,906.3
Transshipment		225.6	241.9	258.4	299.6	341.9	386.0	418.5
Total		$1,090.6	$1,230.0	$1,387.8	$1,774.0	$2,266.9	$2,899.1	$3,324.8
Alternative IVb, Lightering at NFTA								
Transportation Costs								
Domestic	5	$1,420.3	$1,627.9	$1,854.4	$2,421.1	$3,161.1	$4,127.2	$4,772.8
Foreign	7	48.7	55.6	63.5	82.9	108.3	141.4	163.5
Foreign	4	363.8	415.7	475.0	620.2	809.8	1,057.3	1,222.6
Lightering		82.6	94.4	107.9	140.9	183.9	240.1	277.7
Total		$1,915.4	$2,193.6	$2,500.8	$3,265.1	$4,263.1	$5,566.0	$6,436.6

(1) Transshipment Alternatives assume that all iron ore destined for the Union Canal will come from domestic sources.

Table B32 - Transportation Costs Under "With Project" Conditions by Commodity, by Harbor Segment, by Alternatives - Sensitivity Analysis (Tons and Dollars in 1000's) (Cont'd)

Commodity/Location	Vessel Class	1990	1995	2000	2010	2020	2030	2040
LIMESTONE								
Buffalo River								
Tonnage Forecast		97.8	102.0	106.4	115.7	125.9	136.9	141.9
Alternatives IIe, IIIf, IIIg, IVa, Lightering at NFTA								
Transportation Costs								
Domestic	5	$ 510.5	$ 532.4	$ 555.3	$ 604.1	$ 657.1	$ 714.8	$ 740.5
Lightering		48.4	50.5	52.7	57.3	62.3	67.8	70.2
Total		$ 558.4	$ 582.9	$ 608.0	$ 661.4	$ 719.4	$ 782.6	$ 810.7
Alternatives IIIh, IIIi, Lightering at Independent Cement								
Transportation Costs								
Domestic	5	$ 510.5	$ 532.4	$ 555.3	$ 604.1	$ 657.1	$ 714.8	$ 740.5
Lightering		59.7	62.3	64.9	70.6	76.8	83.6	86.6
Total		$ 570.2	$ 594.7	$ 620.2	$ 674.7	$ 733.9	$ 798.4	$ 827.1
Alternative IVb, Lightering at NFTA								
Transportation Costs								
Domestic	5	$ 539.9	$ 563.0	$ 587.2	$ 638.8	$ 694.8	$ 755.8	$ 783.0
Lightering		42.5	44.4	46.3	50.3	54.8	59.6	61.7
Total		$ 582.4	$ 607.4	$ 633.5	$ 689.1	$ 749.6	$ 815.4	$ 844.7
Union Canal								
Tonnage Forecast								
Alternatives IIe, IIIf, IIIg, IVa, Lightering at NFTA								
Transportation Costs								
Domestic	5	$173.9	$197.7	$226.0	$295.0	$385.2	$502.9	$656.6
Lightering		18.6	21.3	24.3	31.8	41.5	54.2	70.7
Total		$191.7	$219.0	$250.3	$326.8	$426.7	$557.1	$727.3
Alternatives IIIh, IIIi, Lightering at Independent Cement								
Transportation Costs								
Domestic	5	$173.1	$197.7	$226.0	$295.0	$385.2	$502.9	$656.6
Lightering		13.7	15.6	17.9	23.3	30.4	39.7	51.9
Total		$186.8	$213.3	$243.9	$318.3	$415.6	$542.6	$708.5
Alternative IVb, Lightering at NFTA								
Transportation Costs								
Domestic	5	$182.9	$209.0	$238.8	$311.7	$407.0	$531.4	$693.8
Lightering		17.2	19.6	22.4	29.3	38.2	49.9	65.2
Total		$200.1	$228.6	$261.2	$341.0	$445.2	$581.3	$759.0
Lackawanna Canal								
Tonnage Forecast		435.8	449.7	464.0	493.9	525.8	559.7	595.8
Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, IVb								
Transportation Costs								
Domestic	6	$2,754.5	$2,842.0	$2,932.2	$3,121.4	$3,322.8	$3,537.1	$3,7[illegible]
GRAIN								
Buffalo River and Canal								
Tonnage Forecast		1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4	1,446.4
Alternatives IId, IIe								
Transportation Costs								
Domestic	5	$14,579.4	$14,579.4	$14,579.4	$14,579.4	$14,579.4	$14,579.4	$14,579.4
SAND AND GRAVEL								
Buffalo Ship Canal								
Tonnage Forecast		235.9	235.9	235.9	235.9	235.9	235.9	235.9
Alternatives IId, IIe - MOD = 22.5 feet								
Transportation Costs								
Domestic	5	$1,969.4	$1,969.4	$1,969.4	$1,969.4	$1,969.4	$1,969.4	$1,969.4
Outer Harbor								
Tonnage Forecast		68.9	68.9	68.9	68.9	68.9	68.9	68.9
Alternatives IIe, IIIf, IIIg, IVa - MOD = 25.5 feet								
Transportation Costs								
Domestic	7	$644.5	$644.5	$644.5	$644.5	$644.5	$644.5	$644.5
Alternatives IIIh, IIIi, IVb - MOD = 24.5 feet								
Transportation Costs:								
Domestic	7	$679.6	$679.6	$679.6	$679.6	$679.6	$679.6	$679.6

Table B33 - Transportation Savings by Alternative - Sensitivity Analysis
(Dollars in 000's)

Commodity/Location	Net Transportation Savings 1990	1995	2000	2010	2020	2030	2040	Average Annual Equivalents
	$	$	$	$	$	$	$	
Alternative IId - North Entrance With MOD of 22.5 feet on the Buffalo River and Ship Canal								
GRAIN								
Buffalo River and Canal	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0
SAND AND GRAVEL								
Buffalo Ship Canal	434.0	434.0	434.0	434.0	434.0	434.0	434.0	434.0
Total Transportation Savings	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0	2,025.0
Alternative IIe - South Entrance With MOD of 25.5 feet in the Outer Harbor and 22.5 Feet MOD on the Buffalo River and Ship Canal								
GRAIN								
Buffalo River and Canal	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0	1,591.0
SAND AND GRAVEL								
Buffalo Ship Canal	434.0	434.0	434.0	434.0	434.0	434.0	434.0	434.0
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Subtotal	532.4	532.4	532.4	532.4	532.4	532.4	532.4	532.4
IRON ORE								
Buffalo River	44.8	46.8	48.9	53.1	66.9	72.6	75.3	51.5
Union Canal	219.1	250.3	286.0	373.6	487.7	636.6	736.2	322.0
Lackawanna Canal	2,731.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	2,995.7	3,115.5	3,245.0	3,422.2	3,849.5	4,217.1	4,545.6	3,340.8
LIMESTONE								
Buffalo River	49.0	50.5	52.6	57.2	62.3	67.7	70.2	54.2
Union Canal	19.6	22.5	25.6	33.4	43.7	57.0	74.5	29.0
Lackawanna Canal	383.5	395.7	408.3	434.6	462.6	492.5	524.3	416.5
Subtotal	452.1	468.7	486.5	525.2	568.6	617.2	669.0	499.7
Total Transportation Savings	5,571.2	5,707.6	5,854.9	6,070.8	6,541.5	6,957.7	7,338.0	5,963.7
Alternative IIIf - Transshipment by Shuttle from NFTA with a MOD of 25.5 feet								
IRON ORE								
Buffalo River	537.3	560.8	584.6	635.8	692.2	752.3	779.7	600.8
Union Canal	1,073.0	1,226.4	1,400.8	1,829.4	2,388.4	3,118.5	3,606.3	1,577.1
Lackawanna Canal	2,731.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	4,342.1	4,605.6	4,895.5	5,560.7	6,375.5	7,378.7	8,120.1	5,145.0
LIMESTONE								
Buffalo River	49.0	50.5	52.6	57.2	62.3	67.7	70.2	54.2
Union Canal	18.6	22.5	25.6	33.4	43.7	57.0	74.5	29.0
Lackawanna Canal	383.5	395.7	408.3	434.6	462.6	492.5	524.3	416.5
Subtotal	452.1	468.7	486.5	525.2	568.6	617.2	669.0	499.7
SAND AND GRAVEL								
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Total Transportation Savings	4,892.6	5,172.7	5,480.4	6,184.3	7,042.5	8,094.3	8,887.5	5,743.1
Alternative IIIg - Transshipment by Rail from NFTA with a Mod of 25.5 Feet								
IRON ORE								
Buffalo River	227.0	280.4	332.6	444.9	601.7	735.0	803.7	371.5
Union Canal	948.4	1,099.9	1,272.6	1,702.0	2,274.4	3,026.0	3,531.9	1,453.0
Lackawanna Canal	2,731.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	3,907.2	4,198.7	4,515.3	5,242.4	6,171.0	7,268.9	8,069.7	4,781.6
LIMESTONE								
Buffalo River	49.0	50.5	52.6	57.2	62.3	67.7	70.2	54.2
Union Canal	19.6	22.5	25.6	33.4	43.7	57.0	74.5	29.0
Lackawanna Canal	383.5	395.7	408.3	434.6	462.6	492.5	524.3	416.5
Subtotal	452.1	468.7	486.5	525.2	568.6	617.2	669.0	499.7
SAND AND GRAVEL								
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Total Transportation Savings	4,457.7	4,765.8	5,100.2	5,866.0	6,838.0	7,984.5	8,837.1	5,379.7

Table B33 - Transportation Savings by Alternative - Sensitivity Analysis (Cont'd)
(Dollars in 000's)

Commodity/Location	Net Transportation Savings							Average Annual Equivalents
	1990	1995	2000	2010	2020	2030	2040	
	$	$	$	$	$	$	$	
Alternative IIIh - Transshipment by Rail from Independent Cement with a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	235.3	289.0	346.1	454.7	607.0	746.5	809.7	381.4
Union Canal	951.2	1,103.1	1,278.0	1,706.7	2,277.5	3,084.1	3,536.6	1,457.2
Lackawanna Canal	2,731.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	3,918.3	4,210.5	4,534.2	5,256.9	6,179.4	7,288.5	8,080.4	4,805.7
LIMESTONE								
Buffalo River	37.2	38.7	40.4	43.9	47.8	51.9	53.8	41.5
Union Canal	24.5	28.2	32.0	41.9	54.8	71.5	93.3	36.3
Lackawanna Canal	383.5	395.7	408.3	434.6	462.6	492.5	524.3	416.5
Subtotal	445.2	462.6	480.7	520.4	565.2	615.9	671.4	494.3
SAND AND GRAVEL								
Outer Harbor	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
Total Transportation Savings	4,426.8	4,736.4	5,078.2	5,840.6	6,807.9	7,967.7	8,815.1	5,363.3
Alternative IIIi - Transshipment by Shuttle from Independent Cement with a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	537.3	560.8	584.6	635.8	692.2	752.3	779.3	600.8
Union Canal	1,073.0	1,226.4	1,400.8	1,829.4	2,388.4	3,118.5	3,606.3	1,577.1
Lackawanna Canal	2,737.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	4,342.1	4,605.6	4,895.5	5,560.7	6,375.5	7,378.7	8,120.1	5,145.0
LIMESTONE								
Buffalo River	37.2	38.7	40.4	43.9	47.8	51.9	53.8	41.5
Union Canal	24.5	28.2	32.0	41.9	54.8	71.5	93.3	36.3
Lackawanna Canal	383.5	395.7	408.5	434.6	462.6	492.5	524.3	416.5
Subtotal	445.2	462.6	480.7	520.4	565.2	615.9	671.4	494.3
SAND AND GRAVEL								
Outer Harbor	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
Total Transportation Savings	4,850.6	5,131.5	5,439.5	6,144.4	6,838.0	7,004.0	8,854.8	5,702.6
	$	$	$	$	$	$	$	
Alternative IVa - South Entrance Improvement with a MOD of 25.5 Feet to the NFTA Seaway Piers								
IRON ORE								
Buffalo River	44.8	41.8	48.9	53.1	66.9	72.6	75.3	51.5
Union Canal	219.1	250.3	286.0	373.6	487.7	636.6	736.2	322.0
Lackawanna Canal	2,731.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	2,995.7	3,115.5	3,245.0	3,422.2	3,849.5	4,217.1	4,545.1	3,340.6
LIMESTONE								
Buffalo River	49.0	50.5	52.6	57.2	62.3	67.7	70.2	54.2
Union Canal	19.6	22.5	25.6	33.4	43.7	57.0	74.5	29.0
Lackawanna Canal	383.5	395.7	408.3	434.6	462.6	492.5	524.3	416.5
Subtotal	452.1	468.7	486.5	525.2	568.6	617.2	669.0	499.7
SAND AND GRAVEL								
Outer Harbor	98.4	98.4	98.4	98.4	98.4	98.4	98.4	98.4
Total Transportation Savings	3,546.2	3,682.6	3,829.9	4,045.8	4,516.5	4,932.7	5,312.5	3,938.7
Alternative IVb - South Entrance Improvement with a MOD of 25.5 Feet								
IRON ORE								
Buffalo River	30.8	32.1	33.6	36.5	39.7	60.5	62.7	35.4
Union Canal	126.4	139.5	165.0	215.6	281.3	367.2	424.8	184.3
Lackawanna Canal	2,731.8	2,818.4	2,910.1	3,095.5	3,294.9	3,507.9	3,734.1	2,967.1
Subtotal	2,890.0	2,990.0	3,108.7	3,347.6	3,615.9	3,935.6	4,221.6	3,186.8
LIMESTONE								
Buffalo River	25.0	26.0	27.1	29.5	32.1	34.9	36.2	27.9
Union Canal	11.2	12.9	14.7	19.2	25.2	32.8	42.8	16.6
Lackawanna Canal	383.5	395.7	408.5	434.6	462.6	492.5	524.3	416.5
Subtotal	419.7	434.6	450.1	483.3	519.9	560.2	603.3	471.0
SAND AND GRAVEL								
Outer Harbor	63.3	63.3	63.3	63.3	63.3	63.3	63.3	63.3
Total Transportation Savings	3,373.0	3,487.9	3,662.1	3,894.2	4,199.1	4,559.1	4,998.2	3,721.1

B7. ADVANCE REPLACEMENT

a. Overview.

Federal improvements may also extend the remaining economic life of existing project features. Whenever a project improvement involves replacement of an existing project related feature, thus extending the engineering life of the affected feature, the benefits associated with the extended life of the affected feature should be included in the project feasibility study.

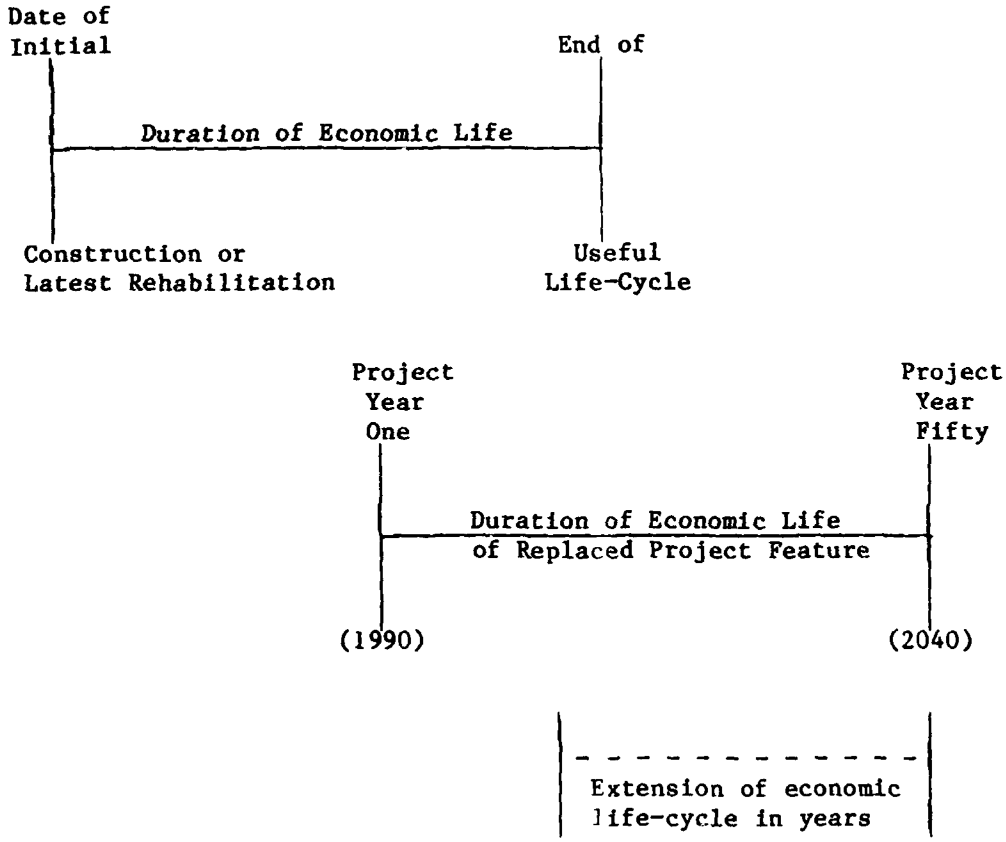
Implementation of Alternatives IId and IIe will involve commitments by local interests to replace existing bulkheads. Deepening of the Buffalo River and Buffalo Ship Canal channels will require the replacement of 7,000 feet of existing bulkhead with new bulkheads since the proposed deepening would render the existing bulkheads unstable. The 50-year expected engineering life of the existing bulkheads, in most instances, has expired. In the case of bulkheads with remaining life, the cost of removing the bulkheads is considered to be greater than the benefit derived from removal and subsequent alternative use or salvage value of the bulkheads. Sloping back waterfront land, an alternative to bulkheading, is impractical because it would require large expenditures for relocating structures such as grain elevators. Therefore, the analysis of Alternatives IId and IIe are based on the installation of new bulkheading compatible with greater depths on the Buffalo River and Buffalo Ship Canal.

At this time, no attempt has been made at quantifying the benefits associated with bulkheading or scaling back the riverbanks. (Possible factors affected, such as the convenience of storage areas and efficiency in docking procedures, have been assessed implicitly.) These benefits need to be refined in subsequent study stages.

Annualized project costs reflect the cost of the new bulkheads throughout the entire 50-year planning period. The assumption under the with project condition for Alternatives IId, and IIe is that users would not tolerate unsafe navigation and would, as noted above, replace the bulkheads.

Local interests would have replaced the Buffalo River and Ship Canal bulkheading as needed in the without project condition. These bulkhead replacement costs would be less than the bulkheading costs presented in Alternatives IId, and IIe. These alternatives provide a greater maximum operating draft on the Buffalo River and Ship Canal than the without project condition provides. The additional cost of the longer bulkheads are compensated for on the benefits side of the equation by reduced transportation costs due to greater channel operating depths. However, the benefits associated with the rest of the bulkheading should also be accounted for on the benefits side. This bulkheading length is equal to the without project condition bulkheading length. Since the useful life of the bulkhead will be extended due to advance replacement by these two alternatives, the benefits accruing from replacing the bulkheads will also be extended. Since bulkhead replacement is economically justifiable, advance replacement benefits must at least equal without project bulkhead replacement costs. Therefore, without project bulkhead replacement costs are taken as a proxy for the benefits that

will accrue due to bulkhead replacement. These costs/benefits are adjusted based on the extension of the useful life of the bulkhead as outlined below.



b. <u>Derivation of Average Annual Advance Replacement Costs</u>.

Advance replacement costs have been computed for bulkhead replacements for Alternatives IId and IIe. This required estimating "replacement-costs-in-kind" and the remaining useful life of the feature after the date of project implementation. Extended useful life is the difference between the useful life-cycle of the project feature (50 years for steel bulkheads) and the remaining life of the present project feature after Project Year Zero (1990). The estimation of average annual replacement costs are based upon a 50-year planning period and a 7.625 percent interest rate. A summary of the inputs and intermediate calculations used to compute average annual replacement costs for Alternatives IId and IIe are shown in Table B34.

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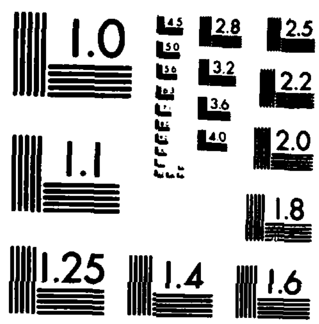

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Table B34 - Average Annual Advance Replacement Costs for Alternatives IId and IIe

Project Feature	Useful Life	Initial Date of Construction	Remaining Life After Project Year Zero (1)	Extended Useful Life (2)	Replacement Costs in Kind (3)	Average Annual Costs (4)	Present Worth of a $1 Per Period (5)	Present Worth Factor (6)	Amortization Factor (7)	Average Annual Advance Replacement Costs
					($000)	($000)				($000)
Bulkheads	50	1954	14	36	20,790	1,626	12.18389	.35745	.07823	554

(1) The remaining life after Project Year Zero (1990) is based upon the average age of the bulkheads. This average age was based upon construction permits submitted to the Buffalo District for bulkhead repairs on the Buffalo River.

(2) The extended useful life is the length of the project planning period (50 years) minus the feature's remaining life after Project Year Zero.

(3) Estimated costs are based upon June 1982 prices.

(4) Multiply the replacement cost in kind by the amortization factor for the bulkheads useful life at a 7.625 percent interest rate. (Bulkhead amortization factor = .07823.)

(5) The present worth of a $1 per period for the feature's extended useful life of 36 years at an interest rate of 7.625 percent.

(6) The present worth factor for a period of time equal to the remaining life of the feature after Project Year Zero (14 years) at an interest rate of 7.625 percent.

(7) The amortization factor for a 50-year project and a 7.625 percent interest rate.

B8. MAINTENANCE DREDGING

a. Overview.

The Buffalo River is maintained to channel depths of 22 feet LWD to facilitate commercial navigation to the upstream limit of the Federal project which is the Erie-Lackawanna Railroad Bridge. Vessel activity has decreased in recent years as several commercial docks have reduced or terminated operations. An upriver steel plant and several grain elevators now constitute the largest users of the commercial channel in the Buffalo River (Figure B1).

Implementation of either rail transshipment plan (Alternatives IIIg, IIIh) would permit transshipment of raw materials from the lakefront to the upriver steel plant. This would effectively preclude the need for continued maintenance of the Federal navigation channel above the elevator used by International Multifoods (i.e., River Mile 2.5). Historical maintenance dredging costs could be eliminated as a result of the implementation of the rail transshipment alternatives. These maintenance costs could then be credited to the project as a benefit.

b. Shoaling at Buffalo Harbor.

At Buffalo Harbor, the primary cause of shoaling is sediment transported into the harbor by the Buffalo River. The upland tributary streams of this river are characterized by steep gradients and streambanks that are easily erodible, especially during flood conditions. The steep gradient and high velocities in these upper reaches transport the eroded materials to the lower reaches of the Buffalo River. Upon entering the lower reaches of the river, where water level gradients are low and where the backwater effect of Lake Erie may be present, much of the stream energy is lost. This results in the deposition of transported materials. Generally, the greatest deposition within the Federal project limits occurs in areas where the Buffalo River widens, such as at the confluence with the Buffalo Ship Canal and in areas where the cross-sectional area of the river is increased as a result of maintenance dredging. The decrease in flow velocity at these enlarged areas causes the lower portion of the river to act as a settling basin.

Actual locations of deposition of river sediments can vary from the Outer Harbor to the upper reaches of the Federally-maintained project. Locations of principal deposition can vary from year to year depending upon Lake Erie water elevations. When lake levels are high the backwater effect of the lake extends to the upper reaches of the Buffalo River causing deposition in its upper reaches. Conversely, when lake levels are low, the backwater regime and locations of sediment deposition approach the mouth of the Buffalo River. With extreme low lake levels, velocities may actually increase in the lower reaches of the river, causing sediments to remain suspended and be transported into the Outer Harbor. This can contribute to the exaggerated deposition of river sediments in the Outer Harbor areas.

Secondary sources of shoaling at Buffalo Harbor are the spillage that occurs along the docks in the Outer Harbor and the littoral shoaling that occurs on the down current side of the breakwaters. Contributions from these sources to the overall shoaling rates at Buffalo Harbor are considered minimal.

Federal maintenance activities in Buffalo Harbor are of two types, dredging activities, which are sensitive to the depth being maintained, and nondredging activities, which are not independent of the channel depth. Nondredging activities consists of breakwater repair, clearing and snagging, and survey and inspection.

c. History of Authorized Depth Changes.

Dredging records for Buffalo Harbor are available from 1950 to date. Until 1954, project depths in the Buffalo Harbor were 21 feet in all protected areas.

In 1956, the Buffalo River, the Buffalo River Ship Canal and the Buffalo River Entrance Channel were deepened to 22 feet, the Northern Outer Channel was deepened to 23 feet, and the Northern Approach Channel was deepened to 25 feet in 1962.

The Southern Outer Harbor was deepened to 25 feet in 1956. In 1964, the South Entrance Channel was deepened to 30 and 29 feet and the South Outer Harbor was deepened to 28 feet. In 1965, the Middle Outer Harbor was deepened to 27 feet (25.5-foot drafts), and a portion of the Middle Outer Harbor, which was deepened to 23 feet in 1956, remains as a turning basin.

d. Maintenance Dredging.

Maintenance dredging in Buffalo Harbor is performed by U.S. Army Corps of Engineers hopper dredges, private contract dredges or a combination of the two. During the past 20 years, the Hopper dredges HOFFMAN and LYMAN have been principally responsible for maintenance dredging in Buffalo Harbor.

These two dredges are nearly identical, having the same hopper capacity (920 cubic yards), maximum dredging depth (36 feet), suction and discharge pipe diameters (18 and 20 inches, respectively), and horsepower (1,400 hp propulsion/410 hp dredging). For work in Buffalo Harbor, the two dredges are interchangeable. Their small size (length - 216 feet, beam - 40 feet 4 inches for the HOFFMAN) make them well suited for work where maneuverability is required, such as in the Buffalo River.

Historically, dredged material removed from Buffalo Harbor was disposed of by open-lake dumping and by occasional shore dumping (possibly beach creation or land development related). Since about 1968, however, dredged material removed from Buffalo Harbor has been confined within designated diked disposal areas. Since 1977, Diked Disposal Area Site 4, adjacent to the South Entrance Channel breakwater, has been used for the disposal of all dredged material.

e. Historical Maintenance Dredging Requirements.

As explained above, the principal source of sediments deposited throughout the Buffalo Harbor is the Buffalo River. Condition surveys are performed annually each spring to determine dredging requirements for the coming year. Dredging is performed in the areas identified by the survey, sometime between late spring and late fall. Areas which are shoaled to less than project depth are dredged to an overdepth of 2 feet. While portions of the dredged channels may survive from one year to the next, dredging is performed in at least some parts of the harbor each year.

Dredging records, which are available from the Annual Reports of the Chief of Engineers since 1950, provide data on dredging in two separate parts of the harbor: (1) dredging in the Buffalo River and Ship Canal, and (2) dredging in all other areas. From 1976 to 1979, only total dredging volumes for the entire Buffalo Harbor were recorded. While this breakdown is not entirely consistent with the areas considered in this report, it is possible to determine an approximate breakdown by areas from other sources.

The North Entrance Channel has required little or no dredging in the past 30 years. This is due to the beneficial effect of adjacent jetties, breakwaters, and the Niagara River current. Annual dredged volumes in the Northern Outer Harbor (23-foot project) and the Buffalo River have been historically included in dredged volumes recorded for the Outer Harbor. Based on recent Corps experience and limited historical data, it would appear that dredged volumes in these areas are on the order of 15 to 20 percent of the volumes of material dredged annually from the Buffalo River. This provides a basis for separating dredging volumes for these areas from volumes recorded for the Outer Harbor. Recent experience indicates that only a very small relative amount of dredging is performed in the South Entrance Channel.

Figure B5, presents historic maintenance dredging volumes for the past 30 years for Buffalo Harbor. An estimated breakdown is shown between the Buffalo River and the Outer Harbor. Values presented on the figure for the Buffalo River include the Buffalo River Ship Canal, the Buffalo River Entrance Channel, the Northern Outer Harbor (23-foot project) and the Northern Entrance Channel. Values presented on the figure for the Outer Harbor include the Middle Outer Harbor (27-foot project including 23-foot turning basin), the Southern Outer Harbor (28-foot project), and the Southern Entrance Channel. Annual quantities were obtained from the U.S. Corps of Engineers Annual Reports.

Dredging volumes in Buffalo Harbor averaged approximately 440,000 cubic yards per year over the 31-year period from 1950 to 1980. The maximum volume dredged during one year was 1,223,974 cubic yards (1967) and the minimum was 84,498 cubic yards (1968). Both of these years, however, appear to have been highly abnormal. A variation of annual dredging volume between 200,000 and 650,000 cubic yards appears to be normal. Dredging volumes since 1972 have been below average.

Dredging volumes in the Buffalo River in the period from 1950 to 1980 averaged about 145,000 cubic yards per year with a variation from average

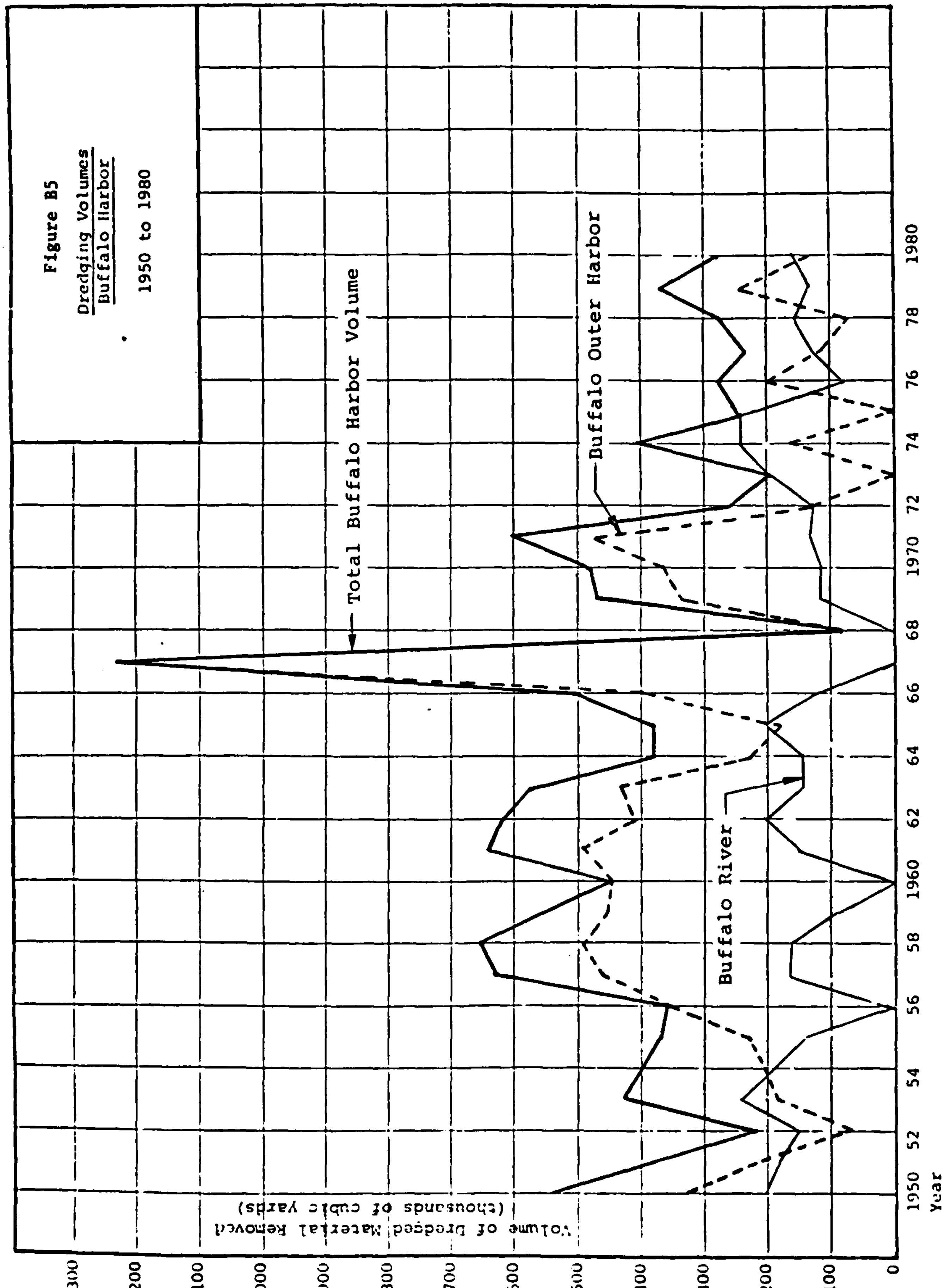

Figure B5
Dredging Volumes
Buffalo Harbor
1950 to 1980
Total Buffalo Harbor Volume
Buffalo Outer Harbor
Buffalo River
Volume of Dredged Material Removed
(thousands of cubic yards)
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
1950
52
54
56
58
1960
62
64
66
68
1970
72
74
76
78
1980
Year

Figure B5

ranging consistently between 0 and 245,000 cubic yards. There does not appear to be any trend towards either increasing or decreasing dredging volumes in the Buffalo River during the period.

f. Maintenance Dredging Costs.

A preliminary dredging investigation of the feasibility of continued maintenance of the Buffalo River, completed in December 1981, has indicated that the cost of dredging the Buffalo River was $3.20 per cubic yard based upon 1979 price levels. Dredged material removed from Buffalo Harbor is currently disposed of in Diked Disposal Area Site 4, located adjacent to the South Entrance Channel breakwater. The approximate charge per cubic yard for dredged material placed in this disposal area was estimated to be $2.45 per cubic yard at 1979 prices. This estimated average financial cost is obtained by dividing the total construction cost of the disposal area by the physical capacity estimated to be 6.9 million cubic yards. Allocation of the construction unit cost to the variable dredge operating unit cost results in total unit costs of $5.65 ($ 1979).

Average annual expenditures to maintain channel depths of 22 feet in the river (which are beneficial to commercial navigation) are about $820,000 based upon 1979 price levels.

Therefore, substantial annual savings (benefits) may accrue to a plan which results in a reduction or elimination of these annual costs.

g. Applicability of Maintenance Dredging Costs Avoided.

Two Outer Harbor rail transshipment plans were formulated which would remove iron ore vessel movements on the Buffalo River. This would effectively eliminate the need for maintenance dredging in the Buffalo River from International Multifoods to the head of the Federal project on the Buffalo River because of iron ore vessel movements.

The announced closing of the Black Rock Lock and deferred maintenance of the Black Rock Ship Canal may result in the relocation of a ship bunkering company, which is presently located downstream of the lock, to an alternate location near the upper limit of navigation of the Buffalo River. A logical site for this firm would be in close proximity to the petroleum docks previously operated by Mobil Oil Corporation above the upriver steel plant. In the event this relocation actually occurred, the minimum channel depth of the Buffalo River above the location of International Multifoods would be determined by the maximum operating draft of the current bunkering vessel now in service. This ship is 136 feet X 32 feet and can operate at a maximum midsummer draft of 12 feet. Continued operation of this vessel would require a maximum channel depth of 14.5 feet. River maintenance could be deferred from present levels to this alternate depth for the period of time it would take natural deposition processes to attain a depth of 14.5 feet. This scenario would effectively limit the maximum annual maintenance savings during the project planning period.

The two Outer Harbor rail transshipment plans do not include the transshipment of limestone. Therefore, upriver movements of vessels carrying limestone would continue and would require the maintenance of existing river channel depths. However, further investigation of this potential annual benefit has been deferred into Stage 3 studies.

B9. BENEFIT-COST ANALYSIS

a. Most Probable Future - Benefits, costs, net benefits, and benefit-cost ratios are presented in Table B35 for Alternatives IId, IIe, IIIf, IIIg, IIIh, IIIi, IVa, and IVb. The benefits associated with these eight alternatives are based upon the commodity projections presented in Table B18.

Benefit-cost ratios are calculated by dividing average annual benefits by average annual costs. Average annual benefits and costs assume 50-year project life and a 7.625 percent interest rate. Table B35 presents the results of the BC economic evaluation for the eight alternatives presented above.

(1) Costs - Costs for project Alternatives IId, IIe, IIf, IIIg, IIIh, IIIi, IVa, and IVb were developed by the Buffalo District. Project first costs included such components as Outer Harbor, Buffalo River and Buffalo Ship Canal deepening, south entrance breakwater removal and extensions, railroad interchange trackage, new bulkheading, and Outer Harbor slip development. Also included in first costs were contingency costs for construction and engineering and supervision. Compound interest during the construction period was estimated and incorporated into each alternative to obtain total investment costs.

Investment costs were then converted to average annual equivalent costs based on an interest rate of 7.625 percent, a 50 year project life and an annualized sinking fund value of .00199. Annual maintenance costs, over and above existing maintenance costs for each plan, were added to the above. The total average annual cost at June 1982 price levels for various project alternatives are presented in Table B35.

(2) Benefits - Benefits for the various project alternatives have been derived from two sources: A decrease in average annual transportation costs between the base case and future improved conditions, and advance replacement benefits. All future benefit streams have been converted to equivalent average annual values.

(a) Advance Replacement Benefits. This benefit category only applies to Alternatives IId and IIe, since these alternatives involved the replacement of existing bulkheads and are taken from Table B39. They are based on Buffalo River and Ship Canal bulkhead replacement costs in kind, the bulkheads remaining useful life past project year 1990, an estimated bulkhead lifespan of 50-years, and a 7.625 percent interest rate.

The average annual replacement benefits for Alternatives IId and IIe were exactly the same since both plans involved the replacement of 7,000 feet of existing bulkheads on the Buffalo River and Ship Canal. The average annual replacement benefits for Alternatives IId and IIe amounted to $554,000. This category accounted for 21 percent and 8 percent of the total average annual benefits for Alternatives IId and IIe respectively.

Table B35 - Summary of Benefit Cost Ratios

Alternative	Reach/Commodity	Average Annual Benefits: Commercial Navigation $	Average Annual Benefits: Advance Replacement $	Average Annual Benefits: Total $	Average Annual Costs $	Net Average Annual Benefits $	Benefit Cost Ratio
IId. North Entrance Improvement	Buffalo River						
	Grain	1,591,000					
	Sand and Gravel	434,000					
	Total	2,025,000	554,000	2,579,000	7,503,000	-4,924,000	0.34
IIe. South Entrance Improvement with Deepening in the Outer Harbor, Buffalo River and Buffalo Ship Canal	Buffalo River						
	Grain	1,591,000					
	Sand and Gravel	434,000					
	Iron Ore	93,100					
	Limestone	91,200					
	Subtotal	2,209,300					
	Outer Harbor						
	Sand and Gravel	98,400					
	Iron Ore	3,564,100					
	Limestone	489,000					
	Subtotal	4,151,500					
	Total	6,360,800	554,000	6,914,800	7,651,400	-736,600	0.90
IIIf. Shuttle Vessel Transshipment of Iron Ore from NFTA Seaway Piers	Buffalo River						
	Iron Ore	994,800					
	Limestone	91,200					
	Subtotal	1,086,000					
	Outer Harbor						
	Sand and Gravel	98,400					
	Iron Ore	4,858,400					
	Limestone	489,000					
	Subtotal	5,445,800					
	Total	6,531,800	N/A	6,531,800	3,347,900	3,183,900	1.95
IIIg. Rail Transshipment of Iron Ore from NFTA Seaway Piers	Buffalo River						
	Iron Ore	940,300					
	Limestone	91,200					
	Subtotal	1,031,500					
	Outer Harbor						
	Sand and Gravel	98,400					
	Iron Ore	4,817,100					
	Limestone	489,000					
	Subtotal	5,404,500					
	Total	6,436,000	N/A	6,436,000	3,383,300	3,052,700	1.90
IIIh. Rail Transhipment of Iron Ore from Independent Cement	Buffalo River						
	Iron Ore	940,300					
	Limestone	69,900					
	Subtotal	1,010,200					
	Outer Harbor						
	Sand and Gravel	63,300					
	Iron Ore	4,823,600					
	Limestone	496,500					
	Subtotal	5,383,400					
	Total	6,393,600	N/A	6,393,600	3,413,700	2,979,900	1.87
IIIi. Shuttle Vessel Transshipment of Iron Ore from Independent Cement	Buffalo River						
	Iron Ore	994,800					
	Limestone	69,900					
	Subtotal	1,064,700					
	Outer Harbor						
	Sand and Gravel	63,300					
	Iron Ore	4,858,400					
	Limestone	496,500					
	Subtotal	5,418,200					
	Total	6,482,900	N/A	6,482,900	3,276,400	3,206,500	1.98
IVa. Outer Harbor Deepening	Buffalo River						
	Iron Ore	93,100					
	Limestone	91,200					
	Subtotal	184,300					
	Outer Harbor						
	Sand and Gravel	98,400					
	Iron Ore	3,564,100					
	Limestone	489,000					
	Subtotal	4,151,500					
	Total	4,335,800	N/A	4,335,800	2,124,000	2,211,800	2.04
IVb. South Entrance Improvement	Buffalo River						
	Iron Ore	63,500					
	Limestone	47,000					
	Subtotal	110,500					
	Outer Harbor						
	Sand and Gravel	63,300					
	Iron Ore	3,424,400					
	Limestone	476,400					
	Subtotal	3,964,100					
	Total	4,074,600	N/A	4,074,600	1,822,700	2,251,900	2.24

(b) Transportation Rate Savings. Transportation rate savings were attributed to all of the Alternatives. The "without" and "with project" annual transportation costs for the eight Alternatives were presented in Tables B25 and B26 respectively.

The decrease between the "without" and "with project" condition transportation costs were developed for the 50-year evaluation period 1990-2040 This time stream of transportation savings was then annualized, given a 50-year project evaluation period, and a 7.625 percent interest rate. These average annual transportation savings were used as approximations of average annual transportation benefits.

The presumptions of deferred recovery for iron ore tonnages over time will impact on the level of total transportation benefits for an alternative which results in the majority of transportation benefits being realized in the future. Since future benefits are discounted more than near term benefits, the benefit estimates for the alternatives will be conservative.

(3) Summary and Conclusions - Alternative IId has a BC ratio of 0.34 with estimated average annual benefits of $2,579,000, and net average annual benefits of minus $4,924,000. Grain, and sand and gravel transportation savings account for 79 percent of this alternatives total average annual benefits. Transportation savings for grain alone account for 62 percent of the total benefits. Average annual advance replacement benefits were $554,000. They comprise 21 percent of this alternatives total benefits.

Alternative IIe had a BC ratio of 0.90 with $6,914,800 of average annual benefits and net average annual benefits of minus $736,000. Commercial navigation benefits are 92 percent of average annual benefits. Advance replacement benefits comprise the remaining 8 percent. The largest commercial navigation benefit categories are: Outer Harbor iron ore (52-percent), Buffalo River grain (32 percent),Outer Harbor limestone (7 percent), and Buffalo River sand and gravel (6 percent).

The shuttle vessel transshipment plan originating from NFTA (IIIf) has a BC ratio of 1.95 with $6,531,800 of average annual benefits and $3,183,900 of net average annual benefits. All benefits come from transportation savings. The major commercial navigation benefits categories are: Outer Harbor iron ore (74 percent), Buffalo River iron ore (15 percent), Outer Harbor limestone (7 percent) and Outer Harbor sand and gravel (2 percent).

The rail transshipment plan orginating from NFTA (IIIg) has a BC ratio of 1.90 with $6,436,000 of average annual benefits and $3,052,700 of net average annual benefits. Again Outer Harbor iron ore comprises the largest percentage of total average annual benefits (75 percent) followed by Buffalo River iron ore (15 percent), Outer Harbor limestone (8 percent) and Outer Harbor sand and gravel (2 percent).

Alternative IIIh is a rail transshipment plan originating from Independent Cement. This alternative has a BC ratio of 1.87 with average annual benefits of $6,393,600 and net average annual benefits of $2,979,900. Outer Harbor

iron ore transportation savings account for the largest percentage of total average annual benefits (75 percent) followed by Buffalo River iron ore (15 percent), Outer Harbor limestone (8 percent) and Buffalo River limestone (1 percent).

The shuttle vessel transshipment plan originating from Independent Cement (IIIi) has a BC ratio of 1.98 with $6,482,900 of average annual benefits and $3,206,500 of net average annual benefits. Again Outer Harbor iron ore accounts for the largest percentage of total average annual benefits (75 percent) followed by Buffalo River iron ore (15 percent), Outer Harbor limestone (8 percent) and Buffalo River limestone (1 percent).

Alternative IVa has a BC ratio of 2.04 with $2,211,800 of net average annual benefits and average annual benefits of $4,335,800. Outer Harbor iron ore comprises 82 percent of total average annual benefits. The next largest benefit category is Outer Harbor limestone (11 percent), followed by Outer Harbor sand and gravel (2 percent), Buffalo River iron ore (2 percent), and Buffalo River limestone (2 percent).

Finally, Alternative IVb has a BC ratio of 2.24 with $2,251,900 of net average annual benefits and average annual benefits of $4,094,600. Outer Harbor iron ore accounts for 84 percent of total average annual benefits. Limestone is the next largest benefit category (12 percent) followed by Buffalo River iron ore (21.5 percent), Outer Harbor sand and gravel (1.5 percent) and Buffalo River limestone (1 percent).

In conclusion Alternative IIIi, the shuttle transshipment plan originating at Independent Cement has the greatest net average annual benefits ($3,206,500) of any of the alternatives. Alternate IVb has the highest BC ratio of all the alternatives at 2.24.

b. Sensitivity Analysis - Section B6 developed transportation costs for the "without" (Table B31), and "with project" (Table B32) condition given a traffic forecast for iron ore and limestone that was less than those used in Section B5. Average annual transportation savings for the low tonnage forecast was presented in Table B33.

The low tonnage forecast assumed only the iron ore and limestone forecasts would change from the projections used in Section B5. The transportation costs, savings, and the BC ratios of all alternatives except IId are affected by this lower tonnage forecast. A comparison of the average annual transportation benefits, transportation costs, and benefit-cost ratio for the two tonnage projections are presented in Table B36.

(1) Transportation Rate Savings - Total Buffalo Harbor iron ore demand decreased by 22 percent and limestone tonnages fell by 21 percent for project year 2040 under the low tonnage scenario. The four transshipment alternatives were impacted the most by the low tonnage forecast. Average annual

Table B36 - Sensitivity Analysis - Comparison of Transportation Benefits, Transportation Costs, and Benefit Cost Ratios

Alternatives	Most Probable Future Projections				Low Tonnage Projections			
	Average Annual Transportation Benefits	Average Annual Transportation Costs	Net Average Annual Benefits	Benefit Cost Ratio	Average Annual Transportation Benefits	Average Annual Transportation Costs	Net Average Annual Benefits	Benefit Cost Ratio
	$	$	$		$	$	$	
IIe	6,914,800	7,651,400	-736,600	.90	5,963,700	7,651,400	-1,687,700	.78
IIIf	6,531,800	3,347,900	3,183,900	1.95	5,743,100	3,347,900	2,395,200	1.72
IIIg	6,436,000	3,383,300	3,052,700	1.90	5,379,700	3,383,300	1,996,400	1.59
IIIH	6,393,600	3,413,700	2,979,900	1.87	5,363,300	3,413,700	1,949,600	1.57
IIIi	6,482,900	3,276,400	3,206,500	1.98	5,702,600	3,276,400	2,426,200	1.74
IVa	4,335,800	2,124,000	2,211,800	2.04	3,938,700	2,124,000	1,814,700	1.85
IVb	4,074,600	1,822,700	2,251,900	2.24	3,721,100	1,822,700	1,898,400	2.04

benefits for the two shuttle vessel transshipment alternatives (IIIf and IIIi) decreased by 12 percent, while the average annual benefits of the rail transshipment alternatives decreased by 16 percent. The shuttle vessel transshipment option from either NFTA or Independent Cement had higher net benefits and BC ratios than the rail transshipment option originating out of NFTA or Independent Cement.

The Outer Harbor deepening improvements with no transshipment, Alternatives IVa, and IVb were affected the least by the low tonnage forecast. The average annual benefits for these alternatives decreased by 9.2 percent and 8.7 percent respectively. Finally the average annual benefits for Alternative IIe decreased by 14 percent. The BC ratio fell from 0.90 to 0.78.

(2) Summary and Conclusions - The low tonnage forecast caused the B/C ratio for Alternative IIe to fall from 0.90 to 0.78. Alternative IIIi, a shuttle vessel transshipment alternative from Independent Cement, still had the greatest net average annual benefits of any of the alternatives at $2,426,200. Also Alternative IVb still had the highest BC ratio of any of the Alternatives at 2.04.

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BUFFALO HARBOR STUDY

SECTION 2 - RECREATION

B10 INTRODUCTION

Boating and other water related activities remain among the most popular forms of outdoor recreation in New York State. Water related recreation is so popular that demand for it greatly exceeds existing opportunities in and around urban areas. Specifically, it is contended that the demand for boating facilities in the vicinity of Buffalo exceeds the capacity of existing facilities.

The purpose of this portion of the study is to provide a preliminary investigation of the demand for boating activity within the study area. This geographic area includes the Buffalo Harbor, the Black Rock Channel, and the upper Niagara River up to the northern Grand Island Bridge in the city of Niagara Falls (Figure 6).

The primary objective is to obtain the necessary field data to define existing conditions for boating activity in the region and to establish an adequate data base for a detailed demand analysis and benefit evaluation in the next stage of study. Analyzing user demand for permanent berths within the study area is necessary for the evaluation of potential expansion of boating facilities at Buffalo. The specific tasks to meet this objective include:

1. Conduct a bibliographic review of information on recreational boating in the region and New York State.

2. Obtain detailed supply inventory of recreational boating facilities in Buffalo area.

3. Obtain New York State boater registration data for Buffalo area based craft population.

4. Determine expenditure data for boating in the Buffalo area.

5. Determine distance distribution of boaters' residences to boating facilities in the Buffalo area.

6. Determine existing fleet mix and boat use patterns in the Buffalo area.

In addition, a review of the existing forecasting techniques and benefit evaluation procedures was undertaken. The forecasting model and preliminary projection of demand will be completed during the next stage of the study. Background material and the necessary data input for the forecasting model have been completed by this investigation. Only rudimentary assumptions on

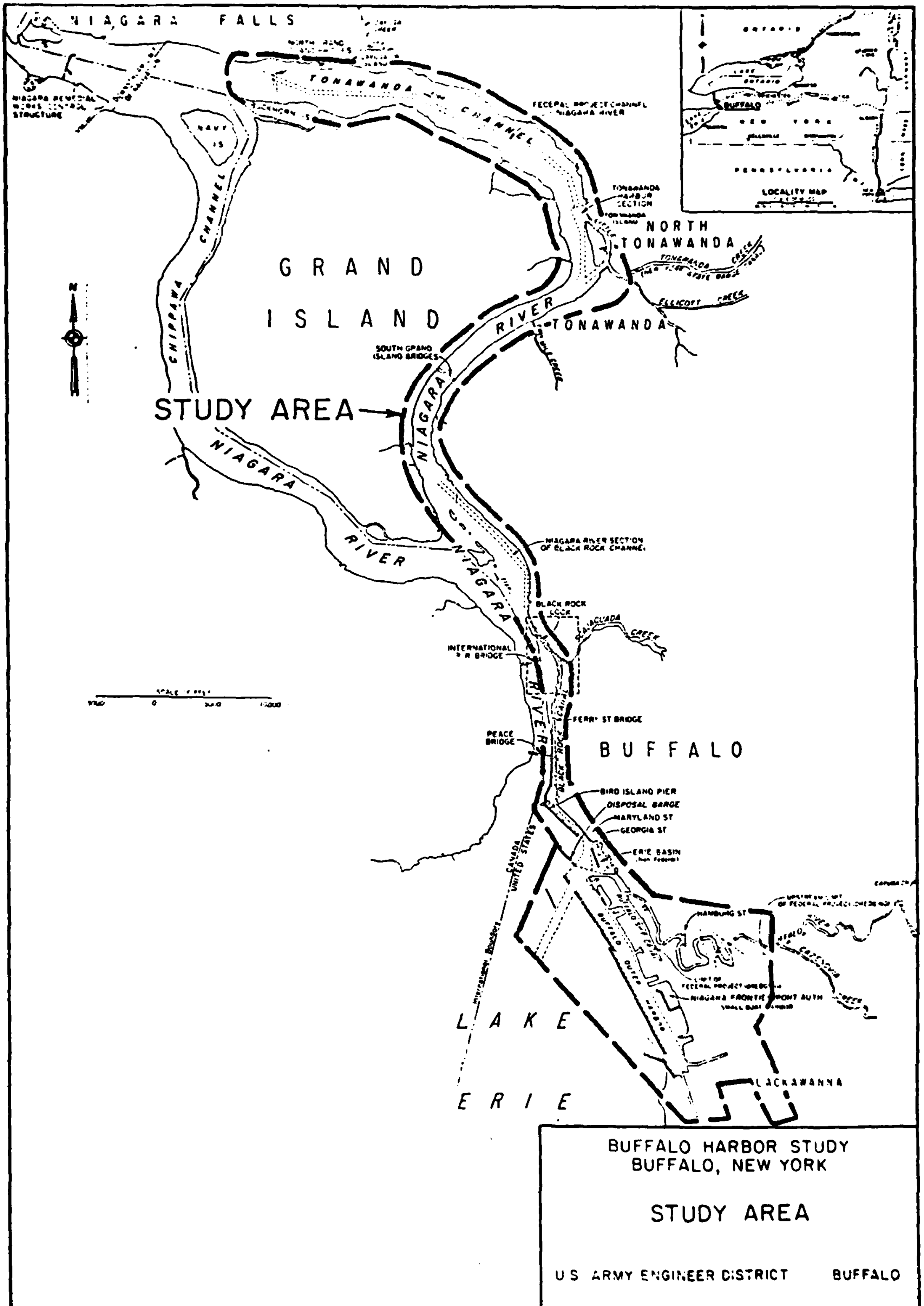

NIAGARA FALLS
TONAWANDA CHANNEL
FEDERAL PROJECT CHANNEL NIAGARA RIVER
NAVY IS
CHIPPAWA CHANNEL
GRAND ISLAND
NORTH TONAWANDA
TONAWANDA
TONAWANDA HARBOR SECTION
ELLICOTT CREEK
RIVER
SOUTH GRAND ISLAND BRIDGES
STUDY AREA
NIAGARA
NIAGARA RIVER
NIAGARA RIVER SECTION OF BLACK ROCK CHANNEL
BLACK ROCK LOCK
SCAJAQUADA CREEK
INTERNATIONAL R R BRIDGE
FERRY ST BRIDGE
PEACE BRIDGE
BUFFALO
BIRD ISLAND PIER
DISPOSAL BARGE
MARYLAND ST
GEORGIA ST
ERIE BASIN
CANADA
UNITED STATES
HAMBURG ST
NIAGARA FRONTIER PORT AUTH
LAKE ERIE
LACKAWANNA
ONTARIO
BUFFALO
NEW YORK
PENNSYLVANIA
LOCALITY MAP
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
STUDY AREA
U S ARMY ENGINEER DISTRICT BUFFALO

FIGURE B6

the demand for boating and an excess demand in relation to the existing supply of marine facilities have been established at this stage of the study.

B11 OVERVIEW OF RECREATIONAL BOATING DEMAND

The Buffalo Harbor Study area is part of the Niagara Frontier Metropolitan Region (the Buffalo SMSA consists of Erie and Niagara Counties). It is the State's second largest Metropolitan area and contains the State's second largest city, Buffalo. The Buffalo SMSA forms the economic core of the surrounding Western New York Region which, in addition to the two county SMSA, includes Alleghany, Cattaraugus, Chautauqua, Genesee, Orleans, and Wyoming Counties.

The Great Lakes and Niagara River provide the region's primary base for recreation, as well as commerce and industry. A wide variety of water based recreational opportunities exist along the shores of Lakes Erie, Ontario, and the Niagara River. In addition to swimming, boating, and water skiing, an excellent muskellunge fishery exists on the upper Niagara River, and salmon and trout fisheries are located in the lower Niagara River, Lake Erie, and Lake Ontario.

The Buffalo SMSA population increased steadily through 1950. Between 1960 and 1970, however, the rate slowed, and is expected to level off by 2000. The region grew at an annual rate of 1.14 percent from a level of 958,500 in 1940 to 1,349,200 in 1970. Between 1970 and 1980, the population declined by 7.9 percent to 1,232,600 (an annual rate of decline of 0.8 percent). This decline is expected to stabilize and the absolute population level is expected to be only 1 percent less by the year 2,000 than it is now (NYSOPR, 1970). The overall pattern of population for the region has been positive except for a substantial decline in central city population. This decline reflects suburbanization to a large degree, and to a lesser extent, a stagnating economy within the city of Buffalo.

Detailed studies of recreation patterns and preferences reveal that age and income are the dominant socio-economic characteristics related to levels of participation, often, on a par with geographic elements. No attempt is made at this stage of the study to provide a complete analysis of the effects of all the socio-economic valuables potentially influencing participation in boating activity. This requires a complex multivariate analysis which will be conducted in the next stage of study. At that time, a demand analysis will be conducted which will involve the process of developing activity estimation and projection models. However, Table B37 provides information on boating participation, based on New York State Office of Parks and Recreation data, to give some feeling for the frequency of participation in recreational boating activities and for the relationship between age, income, and the rate of participation in recreational boating (NYSOPR, 1981a).

Table B37 - Boating Participation Among New York State Adults

Activity	Percent Currently Participating	Frequency of Participation: Median Number of Days Annually	Frequency of Participation: Mean Number of Days Annually	Age of Participation: Median Age	Age of Participation: Mean Age	Household Income of Participants: Median Income	Household Income of Participants: Mean Income
						$	$
Sailing	12.5	3.5	11.7	40.4	38.1	22,723	25,360
Motor Boating	23.9	5.1	13.6	41.0	40.3	21,970	22,780
Canoe/Kayaking/ Rowboating	20.4	3.8	10.7	40.6	39.4	18,305	21,784
All Boating	38.8	6.1	17.7	41.0	40.3	21,893	22,514

SOURCE: NYSOPR, 1981a.

The information provided in Table B37 shows the current participation rates for each form of boating and for the overall category of boating. It also shows the median number of days, median age, and median income of the different types of boaters. Motorboaters engage in the activity more often than the other two forms and comprise a larger percent of the population participating in boating.

The overall relationship between age and income variables and boating activity are inverse. A strong negative relationship with age and a positive one with income occur (NYSOPR, 1981c). The Median age of boaters is 40, and is consistent across all three types of boating activity. In terms of income, sailing is higher than either of the other two forms of boating, while all types of boating have relatively high income levels.

The relationships to both age and income are nonlinear. With age, the major decline comes only in the 50-year age brackets for all categories. For all boating, participation among those less than 25 years of age is 56 percent and is above 50 percent for those people up to age 50. Above this age, decline is severe with 32 percent of those individuals between 50 and 65 years of age participating in boating, while only 15 percent above 65 years of age go boating (NYSOPR, 1981c).

A similar, although opposite, relationship is evident with income. Participation in boating by those with incomes above $20,000 is three times the rate of those with incomes below $10,000. Participation for sailing does not occur until the $15,000 income level is reached and continues to rise steadily with income (NYSOPR, 1981c).

The importance of these socio-economic variables is such that changes in age and income characteristics will result in changes in participation rates for boating activity. Within the Niagara Frontier region (Erie and Niagara Counties) the internal changes in the socio-economic make-up of the population are typical of those occurring throughout the State. That is, the average age of the population is increasing, along with an increase in real income (NYSOPR, 1978). Thus, boating along with other recreational activities that are most sensitive to changes in age and income will tend to increase in both aggregate and per capita demand.

According to the New York Statewide Comprehensive Recreation Plan, the most striking redistribution of recreation demand within the Niagara region is in boating activity. There is a lack of resources in both the Southern Tier and the interior section of the State between the Niagara Frontier area and the Finger Lakes. Considerable numbers of boaters, therefore, come to this area because of the many excellent facilities along Lakes Erie and Ontario, and the Niagara River. Although the area is well-supplied with marine facilities, because of the high population density within the region and the resultant high density of boating activity, the existing accommodations are incapable of meeting future growth in demand. These factors contributed to the departure of vessels to other areas, with 2,070 vessels leaving Erie County, alone, during 1981 (NYSOPR, 1982).

Table B38 summarizes the demand for boating in the Niagara Region for the period 1975-2000 according to the New York Statewide Comprehensive Recreation Plan. Overall growth in boating activity is projected to be approximately 12 percent over the 25-year period. The Statewide Recreation Plan identifies the Niagara Region as being one of the areas within New York State where existing facilities will not meet the growth in demand for boating activities. According to State projections, the need for access and source facilities will continue to grow. Contributing factors to this growth include changes in the socio-economic structure of the population; the stocking of fish and greater overall interest in fishing; the loss of some marinas to waterfront housing and redevelopment; and more, enforced or otherwise, leisure time (NYSOPR, 1982).

Table B38 - Demand for Boating in the Niagara Region, 1975-2000

	1975	2000
Demand at Origin Annual Activity Days	2,736,620	3,058,669
Demand at Destination Annual Activity Days	2,925,206	3,325,565
Percent Change, 1975-2000		11.76
Days of Use per Limit of Public Capacity	72	82

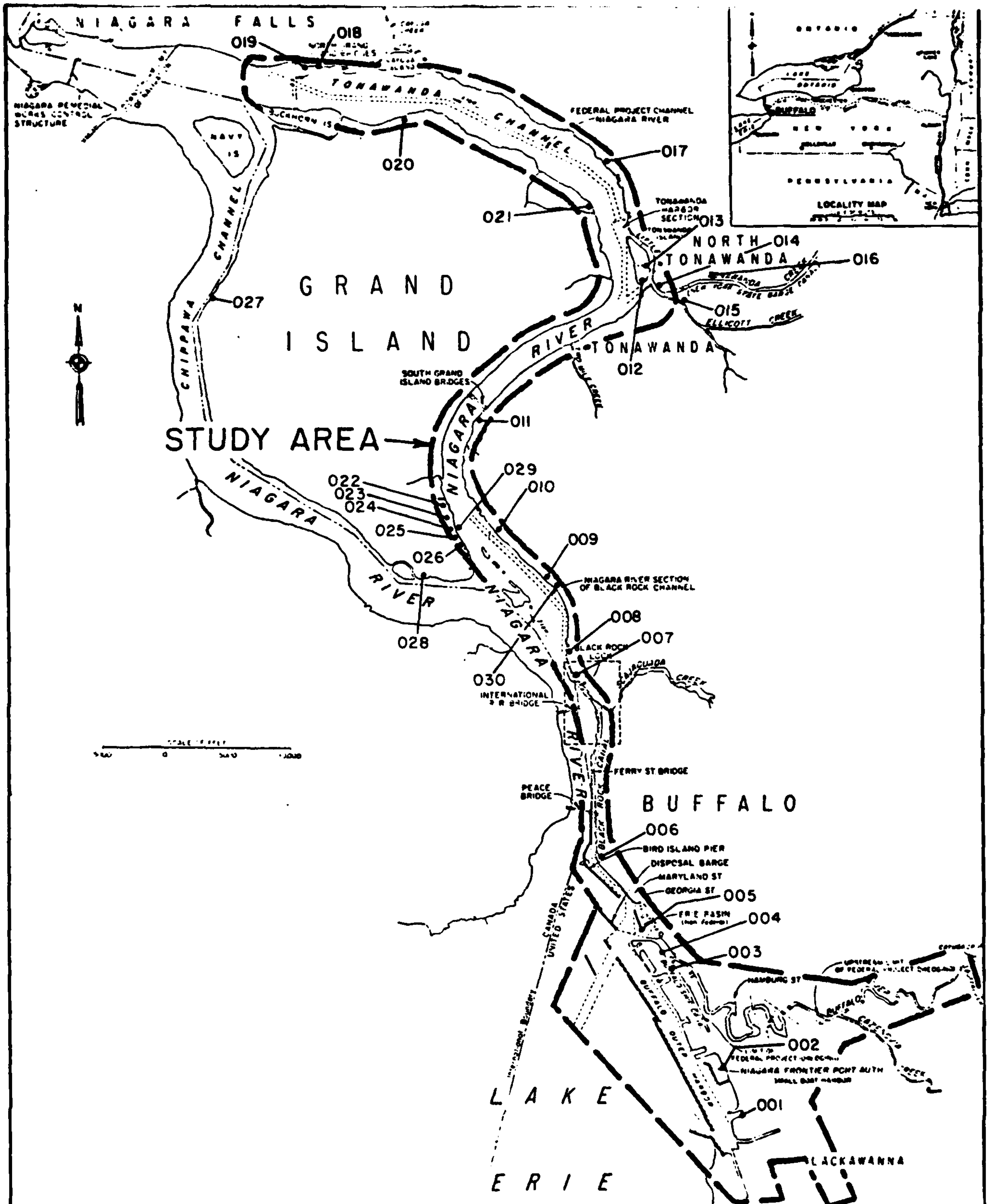
B12 EXISTING CONDITIONS

a. <u>Facilities</u>.

The Buffalo Harbor and upper Niagara River area contain 30 marine facilities. These facilities range from small private yacht and fishing clubs to large commercial and public marinas containing an excess of 300 vessels. The marinas and yacht clubs are located primarily within the harbor area and the East Branch of the Niagara River.

The location of each of the facilities is presented in Figure B7. Eight facilities are found within the city of Buffalo, eleven in the Tonawandas, nine on Grand Island and two within the city of Niagara Falls.

Table B39 illustrates the range in size of the various facilities and the actual number of boats counted at each facility. As noted in the figures presented, there is an excess in the number of boats in relation to the available wet slips within the Buffalo area. This excess can be explained by the use of dry stack storage of boats at facilities where wet berths are not available. A number of marina operators indicated that boat owners who seek seasonal storage facilities prefer wet berths to dry stack facilities. Also, there is a general consensus among numerous marina operators that a lack of dockage facilities and an increasing demand for such facilities exists within the region.



BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

STUDY AREA
MARINA FACILITIES

U S ARMY ENGINEER DISTRICT BUFFALO

FIGURE B7

Table B39 - Survey of Marina Facilities

Marina/Yacht Club	Code Number	Berth/Moorings	Boats Counted
Bouquards Boat Livery	001	39	37
NFTA Small-Boat Harbor	002	357	357
RCR Yacht Inc.	003	86	97
Buffalo R. Marina	004	230	215
Erie Basin Marina	005	280	280
Buffalo Yacht Club	006	45	35
Rich Marine	007	450	500 (1)
Jafco Marina	008	170	155
Hank's Boat Livery	009	62	51
Placid Harbor Marina I	010	200	198
Marina Bay Club	011	110	143
Placid Harbor Marina II	012	70	69
Smith Boys, Inc.	013	149	149
Wardell Boat Yard	014	70	70
Inner Harbor Yacht Club	015	28	30
Hi-Skipper Marina	016	38	59
Niagara River Yacht Club	017	82	38
LaSalle Yacht Club	018	62	62
Century Club	019	10	10
Sandy Beach Yacht Club	020	34	37
Niagara Sailing Club	021	46	85
Buffalo Launch Club	022	49	30
Anchor Marina	023	110	181
Bedell House Annex	024	6	0 (a)

Table B39 - Survey of Marina Facilities (Cont'd)

Marina/Yacht Club	Code Number	Berth/Moorings	Boats Counted
Blue Water Marina	025	40	34
East River Marina	026	57	54
Big Six Creek Marina	027	139	134
Beaver Island State Park: Transient Marina	028	80	0 (a)
Niagara River Fishing	029	29	29
Aqua Lane Marina	030	35	51
Total		3,077 (2)	3,230

(a) Facilities are used exclusively by transient craft which vary on a daily basis.

SOURCE: Survey of Marinas, June 1982.

(1) Data from survey conducted during April 1982.

(2) Excludes slips used exclusively by transient boats.

Many area operators keep waiting lists of boat owners desiring a berthage area upon vacancy. The New York Statewide Comprehensive Recreation Plan alsc identifies the Niagara Frontier (Erie and Niagara Counties) as having insufficient capacity to meet future boating demands (NYSOPR, 1978).

Existing marina facilities provide a range of amenities from parking, water, and electrical hookups to club houses, restaurants and repair services. All of the commercial marinas provide repair services, where as most private clubs do not. Twenty facilities provide lighting, electrical and water hookups; and 10 facilities have associated restaurants or club houses. Amenities also vary with the aesthetics of the specific site of each facility. Some marinas are located in parks or park-like settings while others are located adjacent to commercial or industrial land uses. River location, as opposed to a lake location, is also an important factor as small craft and silboats at marinas located on the Niagara River rely on the Black Rock Lock for safe access to Lake Erie.

Each of the marinas surveyed provide launching facilities. However, many of these are available for slip renters only or are used for launching boats at the beginning of the boating season and for taking them out of the water at the end of the season. A total of 44 launch ramps and/or hoists exists within the study area.

An assessment of the number of facilities within Western New York outside of the study area was also conducted using available data to determine the number of alternative slips available to boaters in the Buffalo area (MRI, 1979). It is assumed that these alternative facilities will attract boaters from the Buffalo area since an excess of boats in relation to existing dockage facilities exists within the study area.

Each facility and the number of slips at each facility was counted on the Lake Erie shore of Chautauqua and Erie Counties; the Lake Ontario shore of Niagara and Orleans Counties; and the lower Niagara River. A total of 28 alternative facilities was counted containing 1,507 wet berths or moorings. Of the total number of slips counted, 726 are located on Lake Ontario, 361 on the lower Niagara River, and 420 on Lake Erie. Also, marina facilities and launch ramps are maintained on the Canadian shore of the Niagara River by the Niagara Parks Commission. These facilities provide alternatives to marinas on the American side and attract some of the excess demand for boating facilities in the Western New York region.

Average dockage fees for slip rental at the facilities surveyed are presented in Table B40. The fees range from \$223.24 for a 16-foot boat to \$497.79 for a 40-foot boat. The average dockage fee for all boats in the Buffalo Harbor Study area is \$369.60 per foot. Other annual boating expenditures such as fuel and oil costs; repairs, service and maintenance costs; and the cost of trailer depreciation are discussed in a separate section.

b. Characteristics of Present Boating Activities.

Characteristics of the existing recreational fleet mix were developed from data collected during the survey of marina facilities and characteristics of a sample of New York State registered boats at these facilities. Statistical information was collected on this sample utilizing 1982 New York State Department of Motor Vehicles boat registration computer data. The registration data includes information on the boat owner's residence, make and length of boats, hull type, propulsion and principal county of use. A computer analysis using an SPSS program (Statistical Packages for the Social Sciences) was conducted to develop recreational fleet mix statistics. In using New York State data, it should be noted that the number of sailboats and other nonmotorized craft are underestimated because New York State does not require nonpowered craft to be registered with the Department of Motor Vehicles (Brown and Noden, 1977).

The recreational fleet mix for the Buffalo Harbor Study area is summarized in Table B41. A sample of 1,633 registered boats was used in the computer analysis to generate the fleet mix data (1). A percentage distribution of the sample data for each class and length category was then applied to the total boat count of 3,230 boats based at study area marinas to estimate characteristics of the total recreational fleet mix.

(1) Over 2,000 registration numbers were collected from the boats at the 30 facilities in the area. Information for 1,633 of these numbers was obtainable from the NYSDMV computer tape.

Table B40 - Average Dockage Fees

Length of Boat (Feet)	Average Dockage Fees $
16	223.24
17	232.41
18	241.58
19	269.55
20	285.39
21	294.56
22	310.73
23	319.90
24	329.87
25	339.07
26	348.27
27	349.00
28	379.14
29	387.57
30	403.00
31	411.75
32	421.64
33	430.43
34	439.21
35	448.00
36	456.79
37	465.57
38	474.36
39	483.14
40	497.29

Table B41 - Buffalo Harbor Study Area Based Recreational Fleet Mix

Boat Class/Length (Feet)	Percent Distribution	Numbers of Boats
Outboards	28.6	924
Less Than 16 Feet	(23.7)	(219)
16-25	(70.7)	(653)
26-39	(4.8)	(44)
40-64	(0.2)	(2)
Unspecified	(0.6)	(6)
Inboards	26.9	869
Less than 16 Feet	(0.0)	(0)
16-25	(37.7)	(328)
26-39	(60.1)	(522)
40-64	(2.0)	(17)
Unspecified	(0.2)	(2)
Inboards/Outdrives	28.6	924
Less than 16	(0.2)	(2)
16-25	(92.5)	(854)
26-39	(6.9)	(64)
40-64	(0.3)	(4)
Unspecified	(0.0)	(0)
Sailboats	9.2	297
Less than 16 Feet	(1.2)	(4)
16-25	(74.4)	(221)
26-39	(24.4)	(72)
40-64	(0.0)	(0)

Table B41 - Buffalo Harbor Study Area Based Recreational Fleet Mix (Cont'd)

Boat Class/Length (Feet)	Percent Distribution	Numbers of Boats
Unspecified	(0.0)	(0)
Other	6.7	216
Less than 16 Feet	(4.3)	(9)
16-25	(61.7)	(133)
26-39	(28.7)	(62)
40-64	(1.1)	(3)
Unspecified	(4.3)	(9)
All Boat Types	100.0	3,230

The data generated indicates that in 1982 approximately 29 percent of the total number of boats are outboard, 27 percent are inboard, 29 percent are inboard/outdrives, 9 percent are sailboats, and the remaining 6 percent are unclassified. In terms of length, 7 percent of all vessels within the study area are under 16 feet, 68 percent are 16 to 25 percent, 24 percent are 26 to 39 feet, and 1 percent are 40 feet or greater in length. Table B42 summarizes the average length of all craft within the study area by boat type.

Table B42 - Average Boat Length of Buffalo Harbor Study Area Based Boats

Boat Class	Average Length of Boat			
	Total (Feet)	Erie County (Feet)	Niagara County (Feet)	Other (Feet)
Outboards	20.8	18.0	19.2	25.2
Inboards	28.0	26.9	28.7	28.3
Inboards/Outdrives	21.3	21.0	22.8	20.0
Sailboats	24.2	23.7	24.0	25.0
Other	25.1	22.6	26.2	26.5
All Boats	22.0	21.7	24.4	26.3

The presence of different craft types indicates different types of uses. Large inboard and cruiser types are frequently used for overnight and longer-term lake excursions, whereas, smaller inboard and outboard craft are more frequently used for short-term lake and river fishing and pleasure cruising close to shore and near breakwaters. Also, discussions with marina operators have indicated that there has been an increase in the number of auxilary powered and smaller nonauxilary powered sailboats in the Buffalo Harbor area. These discussions reveal that sailing is considered to be one of the major growth sectors in recreational boating activity within the region.

c. Seasonal Recreational Boating Expenditures.

The purpose of this section is to determine the seasonal operating and maintenance expenditures incurred by recreational boaters. Expenditure calculations are based on August 1982 prices for fuel, oil, and maintenance costs compiled through telephone conversations and personal interviews with nine Buffalo area marina operators and sale/service firms. Operating expenditures include seasonal fuel and oil costs, while seasonal maintenance and repair expenditures include tune-up, lower unit lubrication, and winterization costs. Trailer maintenance costs were also included as seasonal boating expenditures.

This section calculates seasonal expenditures for recreational boaters who engage in fishing, pleasure cruising, water skiing, and other leisure-related boating activities. Seasonal maintenance and operating expenditures were calculated for the following boat length classes: less than 16 feet, 16-25 feet, and 26-39 feet.

(1) Fuel and Oil Expenditures.

Seasonal fuel and oil expenditures for outboard boats varied from $77.22 for the less than 16 foot class to $508.37 for the 16 to 25 foot class, to $1,258.78 for the 26 to 39 foot length class as illustrated in Table B43. Seasonal fuel and oil expenditures for inboard and inboard/outdrive boats varied from $501.31 for less than 16 foot class, to $801.61 for the 16 to 25 foot class, to $1,860.85 for the 26 to 39 foot length class, as illustrated in Table B44.

Table B43 - Seasonal Maintenance and Operating Expenses for Outboards

Horsepower	2-35	40-140	150-300
Class	Low	Mid-Range	High
Boat-Length Class	<16 Feet	16-25 Feet	26-39 Feet
Average Tune-Up Costs	$53.50	$70.50	$87.50
Lower Lubrication Costs	$10.00	$10.00	$10.00
Winterization	$35.00	$35.00	$35.00
Total Maintenance and Repair	$98.50	$115.50	$132.50
Average Fuel Costs	$65.52	$431.34	$1,068.80
Average Oil Costs	$11.70	$77.03	$190.78
Total Fuel and Oil Costs	$77.22	$508.37	$1,258.78
Average Annual Trailor Costs	$60.00	$60.00	$60.00
Total Seasonal Maintenance and Operating Expenses	$235.72	$683.87	$1,451.28

Using Manufacturers Specifications, outboard motor classes were determined by horsepower rating as follows:

2 horsepower-35 horsepower, Low; 40 horespower-140 horsepower, Mid Range; 150 horsepower-300 horsepower, High. These horsepower rating classes were assigned to the less than 16 foot, 16 to 25 foot, and 26 to 39 foot, length classes respectively. Inboard and inboard/outdrive boats were likewise assigned to boat length classes according to their horsepower ratings. The horsepower classes were set up as follows: 120 horespower, Low, 198 horespower, Mid Range; 370 horespower, High and assigned to the less than 16-foot, 16 to 25 foot, and 26 to 39 foot length classifications respectively. It was assumed at this point that inboard and inboard/outdrive boats have comparable fuel and oil consumption rates.

Table B44 - Seasonal Maintenance and Operating Expenses for Inboard/Outdrives

Horsepower	120	198	370
Class	Low	Medium	High
Boat-Length Class	<16 Feet	16-25 Feet	26-39 Feet
Average Tune-Up Costs	$98.00	$98.00	$98.00
Lower Lubrication Costs	$40.75	$40.75	$40.75
Winterization	$90.00	$90.00	$90.00
Total Maintenance and Repair	$228.75	$228.75	$228.75
Average Fuel Costs	$492.31	$797.61	$1,851.85
Average Oil Costs	$9.00	9.00	9.00
Total Fuel and Oil Costs	$501.31	$801.61	$1,860.85
Average Annual Trailor Costs	$60.00	$60.00	$60.00
Total Seasonal Maintenance and Operating Expenses	$790.06	$1,090.36	$2,149.60

A methodology for calculating seasonal fuel expenditures has been utilized based on a fuel consumption equation for calculating the gallons per hour consumed at wide-open throttle by the engine's rated horespower and applying a fuel consumption factor based on the ratio of RPM's at a specific speed to the

RPM at wide-open throttle (Carlson, 1981). The total seasonal fuel expenditure for each boat length class was then calculated by multiplying the gallons per hour, seasonal usage hours (hours per year), and the price per gallon. Seasonal usage hours were computed by averaging the usage hours per year as estimated by the various marina operators contacted. This resulted in an average seasonal use of 65 hours. The gasoline price per gallon was assumed to be $1.40 at 1982 price levels.

Seasonal oil expenditures for outboard boats varied from $11.70 for the less than 16 foot class to $77.03 for the 16 to 25 foot class to $190.78 for the 26 to 39 foot length class. The seasonal oil expenditures for inboard and inboard/outdrive boats remained constant at $9.00.

Outboard motors have a fuel to oil mixture of 1:50 which approximates one pint of oil per six gallons of gasoline. Having previously calculated the seasonal fuel consumption in gallons, the seasonal oil consumption (August 1982 price levels) for each boat length class is calculated by multiplying the gallons per hour, seasonal usage hours and the price per pint of oil. The price of oil is assumed to be $1.50/pint in August 1982 price levels.

Inboard and inboard/outdrive boats seasonally require approximately five quarts of oil (crankcase) and one quart for refill. In terms of August 1982 price levels this equals $9.00/year. This consumption rate remains constant over the various boat length classifications.

(2) Seasonal Maintenance and Repair Expenditures.

Maintenance and repair expenditures are defined as those costs incurred at regular and predictable intervals which are necessary to keep the boating equipment in proper working order. These expenditures include: tune-up (points, plugs, filters, ignition check), lower unit lubrication and winterization (including antifreeze) costs, and are summarized in Tables B43 and B44. The above expenditures all include labor plus parts. The expenses, however, are exclusive of infrequent or extraordinary repairs which might be due to improper or abnormal use, such as major engine and lower unit overhauls, water pump, and prop replacement. Seasonal maintenance and repair costs were calculated for each boat length class using the same method of assigning horsepower rating class to boat length classes as was used for the fuel and oil expenditure calculations. The expenditures for the various length classes were calculated by averaging the prices charged by the service firms contacted for the particular repair or maintenance service performed.

The seasonal maintenance and repair expenditures for outboard motors varied from $98.50 for the less than 16 foot class to $115.50 for the 16 to 25 foot class to $132.50 for the 26 to 39 foot length class.

Seasonal maintenance and repair expenditures for inboard and inboard/outdrive boats remained constant for the various boat length classifications at $228.75.

The seasonal maintenance and repair costs are contingent upon whether these expenditures are, in fact, incurred. Owner's neglect and manufacturer's claims that their new models are virtually tune-up free or require minimal maintenance over 3-5 year periods suggest that seasonal maintenance and repair expenditures may be considerably lower than indicated above. However, the above calculations are based upon the assumptions that the boat is well maintained following the manufacturers maintenance schedule and that the majority of recreational craft are powered with older model (pre 1978) motors. On the other hand, if one of the less frequent expenditures mentioned above is necessary, seasonal maintenance and repair expenditures may, in fact, be considerably higher.

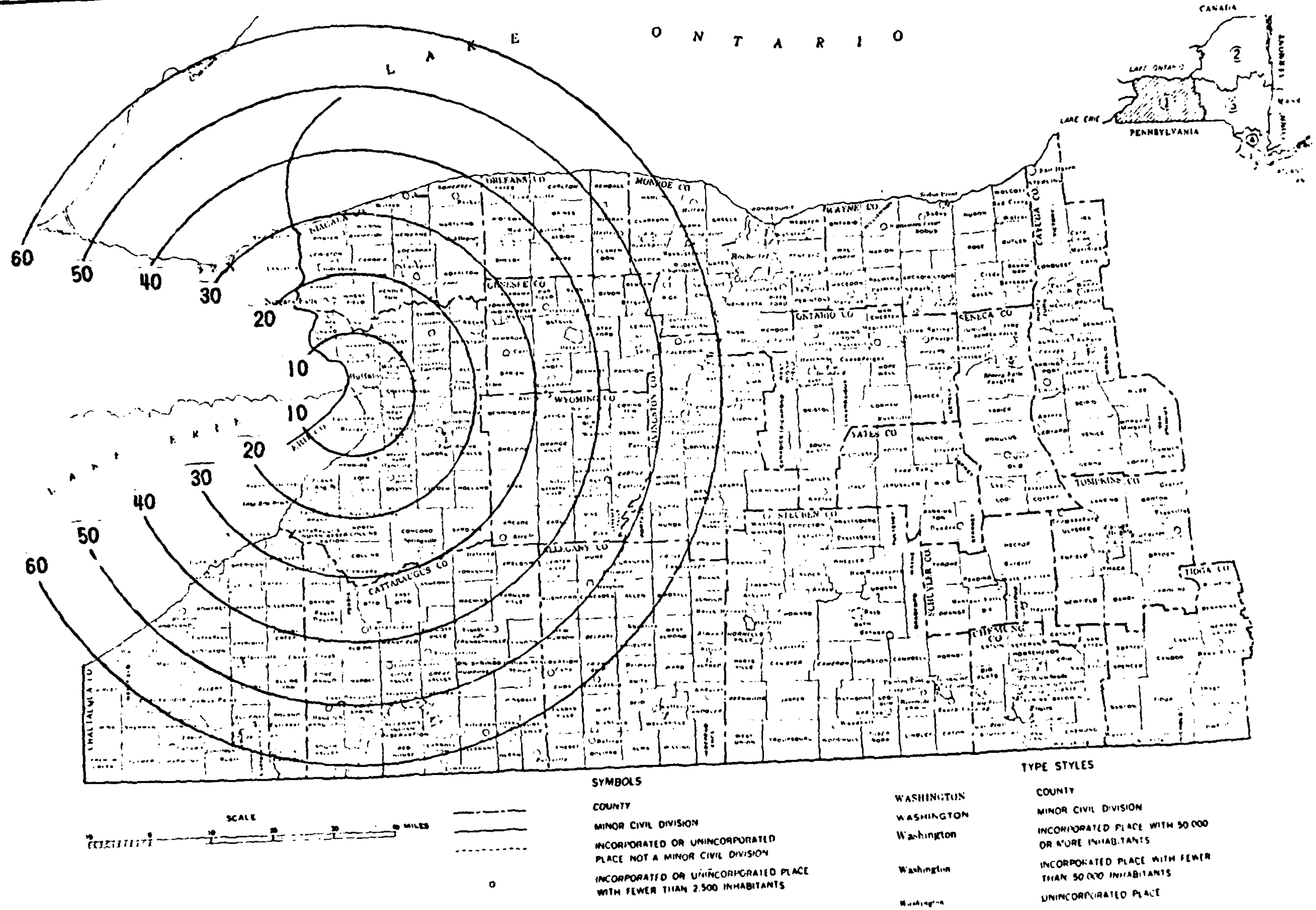
(3) Seasonal Trailering Costs.

Seasonal trailering expenditures were estimated at $60 per year and are presented in Tables B43 and B44. Given the wide range of trailer models and subsequent variations in maintenance costs, the seasonal expenditure was calculated by computing an average cost for a new trailer at August 1982 price levels and depreciating the cost over 25 years. A $1,500 cost for a new trailer with 25-year depreciation (straight line) results in an average annual cost of $60. This amount is intended to cover such trailering costs as: tire and brake wear, and running light and roller replacement as well as overall wear to the trailer.

d. Distance.

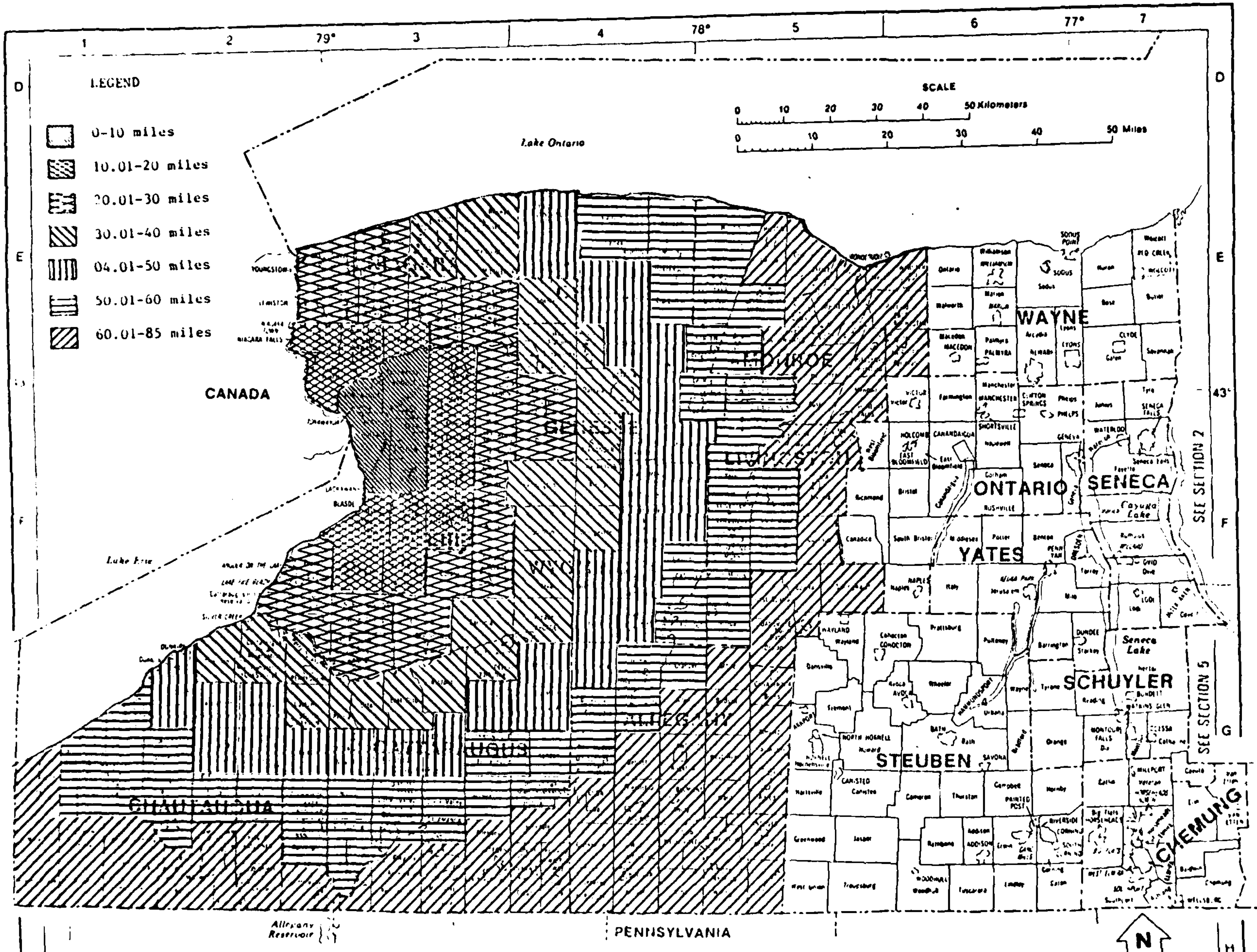
Distance between residential origins and boating facility destinations is an important variable used in the benefit evaluation for new marina facilities' development. It is a major element of the travel cost method of analysis for the economic assessment of new marina facilities or expansion of existing facilities. For this purpose, data on distance was generated for the benefit-cost analysis to be developed in the next stage of the study.

Road mile distance to the centroid of Buffalo marine facilities (the Intersection of I-190 and Route 5) was measured for all minor civil divisions (MCD's) in 10 western New York Counties. MCD's were grouped in zones at 10 mile intervals as shown on Figures B8 and B9. A distribution of the total number of locally based boats by residence of owner was also developed over this range of distance. Table B45 provides a summary of population, the percent of Buffalo Harbor Study area based boats, the number of permanent based boats in Buffalo, and the number of boats per 1,000 persons by distance zones. The total population in Western New York within an 85-mile range from Buffalo according to the 1980 Census is 2,423,914. The population within each zone varies from a high of 837,553 which includes the Rochester area to a low of 95,876 which encompasses a primarily rural area in the Genessee Valley and Lake Ontario plain west of the city of Rochester. The largest population concentration is in the first two intervals (up to the 20-mile interval) which includes the major portion of the Buffalo Metropolitan area. These two intervals have a total population of 1,078,018.



ROAD MILE RANGES FROM BUFFALO, NEW YORK

FIGURE B8



ROAD MILE DISTANCE TO BUFFALO HARBOR BY MINOR CIVIL DIVISION POPULATION CENTROID

FIGURE B9

Table B45 - Population and Buffalo Harbor Study Area Boat Distribution by Road Mile Zones

	Distance in Miles From Buffalo (1)							
	0-10	10.01-20	20.01-30	30.01-40	40.01-50	50.01-60	60.01-80	Total
Population (2)	759,891	318,127	153,129	97,222	95,876	162,146	837,553	2,423,944
Percentage Distribution	66.4	29.1	3.1	0.3	0.2	0.3	0.6	100.0
Distribution of Permanent Based Boats in Buffalo(3)	2,145	940	100	10	6	10	19	3,230
Boats/1,000 persons	2.8216	2.9587	0.6470	0.1019	0.0620	0.0611	0.0231	1.3325

(1) Intervals based on road mile distance from the intersection of Routes I-190 and 5.
(2) 1980 U.S. Census of Population.
(3) Distribution of Buffalo area facilities permanent berthed boats is derived from survey of boat registrations conducted by the Buffalo District.

The distribution of all Buffalo Harbor Study area based boats by residence of owner is concentrated within the 10 and 20 mile zones with over 66 percent within 10 miles and 29 percent within the 10-20 mile zones. Thus 95 percent of all owners of Buffalo area based boats reside within the 0 to 20 mile interval and only 5 percent between 20 and 85 miles.

The per capita number of Buffalo Harbor Study area based boats in western New York is 1.33. The distribution of Buffalo area based boats per 1,000 persons decreases with distance. At the 0-10 mile interval, there are 2.82 boats per 1,000 persons, and at the 10-20 mile interval 2.96 boats per 1,000 persons. Beyond the 20-mile interval, the number of boats per 1,000 persons decrease to less than one and approaches zero beyond the 60-mile interval.

An analysis of the distance from residence to marine facilities reveals that the origin of the Buffalo Harbor area based recreational fleet is concentrated in a relatively small area within 20 miles of Buffalo. Thus, the major source area for the recreational fleet is the Buffalo Metropolitan Area. With greater distance, the number of boats based within the Buffalo Harbor Study area decreases, particularly beyond the 30-mile zone.

B13 DEMAND ANALYSIS AND BENEFIT EVALUATION

As previously stated, the preliminary analysis conducted for this stage of study provides the basic data requirements for forecasting user demand for boating in the Buffalo area and evaluating the feasibility of potential marine facility expansion in Buffalo. These tasks will be undertaken in the next stage of study. The demand analysis will be based on the development of a forecasting model which utilizes multivariate regression analysis. To determine projected demand for permanent berths in the Buffalo area, independent variables including the number of registered boats, distance from residence to marinas, capacity and availabililty of alternative sites, and various socio-economic and demographic variables will be considered in the development of the model. Recreational navigation benefits for harbor improvements can be measured by the amount users have to spend to engage in the recreational experience plus the amount users would be willing to spend above their existing expenditures. The "travel cost method" will be used to approximate consumer surplus or net willingness to pay. The travel cost method is based on the premise that per capita demand for a recreation site will decrease as out-of-pocket and time costs of traveling from place of origin to the site increase. The method consists of deriving a demand curve for a recreation site by using the variable costs of travel and the value of time as proxies for price.

B14 OFFSHORE ISLAND PRELIMINARY FEASIBILITY EVALUATION

a. Recreation Benefits.

A preliminary analysis was conducted on the feasibility of constructing an offshore island for recreation purposes at a location within the Buffalo Harbor Study area. A specific location has not been targeted for development at this stage of the study. A range of 50 to 150 acres was chosen as the optimum development size. For the purposes of this preliminary analysis

100 acres was utilized to develop recreational benefits that would result from the construction of an offshore island. The island will be constructed from deposits of dredged material or other appropriate fill such as slag material. The main activities on the island will be picnicking, freshwater swimming, fishing, and boating (boat marina). Participants in day-use activities will be shuttled by ferry from a specific point on the mainland where parking will be available. At this phase of the study, general recreational activities are assumed to be feasible, however, this does not preclude the possibility of specialized, high quality activities included at a future planning period. Some activities that deserve consideration because of the unique concept of this recreation area are scuba diving, wind surfing, and sailing classes.

The New York Statewide Comprehensive Recreation Plan and technical reports from the State Office of Parks and Recreation were utilized for substantiation of demand in the Niagara Frontier recreation area which includes Niagara and Erie Counties.

A brief discussion of each recreation activity along with some tables follows.

Table B46 Population Projections for the Niagara Recreation Area

Year	City of Buffalo	Erie County Less Buffalo	Niagara County
1980	357,870	657,600	227,100
1990	356,500	734,600	240,200
2000	335,200	784,500	235,500
2010	335,200	826,500	235,500
2020	335,200	869,100	235,500
2030	335,200	911,500	235,500
2040	335,200	953,700	235,500

SOURCE: 1980 U.S. Census; New York State Department of Commerce, 1980.

The Niagara Frontier is the State's second largest metropolitan area and contains the State's second largest city, Buffalo. The area's 1.3 million people comprise 7.4 percent of the state's population. Within the city of Buffalo, the declining growing rate shown in Table B46 reflects a migration from urban to suburban areas. The bulk of recreation demand generated in the Niagara Region comes from the Buffalo Met politan area thus the recreational patterns in the Niagara Region are similar to those in other urban areas of the State.

(1) Picnicking - Because of its broad appeal, the growth in picnicking will follow population growth trends closely. The season extends approximately from 15 May-15 September with 38 peak days and 86 nonpeak days. Fifty acres of the 100-acre island will be devoted to this passive recreation activity. According to New York State Parks and Recreation, 70 percent of the regional population engages in this activity at least once during the season. The Erie-Niagara Region has 194 public parks with picnic facilities and the Buffalo Metropolitan area has 21 public picnic areas. The 70 percent participation was adjusted to allocate a percentage of demand for the new site. At no time in the 50-year planning period (1990-2040) does demand exceed the supply capacity. A unit day value of $3.60 was derived from the current published schedule (K-3-1 FY 1982) and applied to the estimated annual use over the 50-year period. The average annual recreation value for picnicking is estimated to be $52,409.

(2) Fishing - The 100 acre offshore island will provide an estimated 6,000 feet of access for freshwater fishing. The season extends from 1 April-30 September with an adjustment of 10 percent for bad weather. According to this schedule, there are 50 peak days and 115 nonpeak days in the season. The catch consists of walleye, salmonids, and panfish. Since fishing access is limited in the Niagara region, demand was not adjusted for competitive sites. The State's salmonid stocking program has further accentuated the need for additional access. Daily peak capacity is estimated to be 1,200 users, nonpeak or weekday use is assumed to be 20 percent of peak capacity. Total annual user days are estimated at 87,600. The $3.82 unit day value is applied to the total annual user days to derive a recreation fishing value of $334,600.

(3) Swimming - Approximately 10 acres of the 100 acre island will be designated as a fresh water swimming area. The season extends from 1 June to 1 September and has 37 peak days and 85 nonpeak days. According to the New York State Recreation data 57 percent of the Niagara region population participates in fresh water swimming. There are 42 public beaches in the recreational area that compete for allocation of demand. The unit day value of $3.60 applied to the annual use derived an annual recreation value for swimming of $741,762.

(4) Recreational Navigation - According to the space criterion for small-boat harbor design, the 30 remaining acres of the island can accommodate 787 craft. However, due to space needed for restroom facilities, fuel service, bait stores, minor concessions, the accommodation of 500 craft will be assumed for this analysis. The existing fleet in the Buffalo area is composed of 7 percent in the less than 16-foot, 68 percent have a length of 16 to 25 foot and 24 percent in the 26 to 39-foot length, and 1 percent are 40 feet or greater. It is assumed that the same distribution will be similar in the new marina. It is also assumed that all the slips will be utilized. An analysis of 1981 recreational boating in New York State has determined that in spite of Niagara and Erie County's position on lake waters and well protected harbors, there is heavy outmigration because the accommodations are incapable of meeting demands. The popular trend of private waterfront condominium ownership with marine facilities emphasizes a need for public water

access in the Buffalo area for a great number of people who cannot participate in the waterfront condominium movement. Annual boat maintenance expenditures, excluding purchase price, are used as a proxy to determine recreation navigation values. In 1980, approximately $1,200 was spent annually by the Lake Erie boaters. This included average seasonal docking fees of $10.25/feet. In 1982, docking fees in the Buffalo area ranged from 12.38/feet to 14.26/feet. This represents a 30 percent increase from 1980. This increase is applied to the total annual expenditure of $1,200 to derive a 1982 expenditure of $1,560, say $1,500. The total annual recreation value for the 500 boat marina is $750,000. A summary of the recreation values that are benefits to the off-shore island are listed below (Table B47).

Table B47 - Summary of Average Annual Recreation Benefits 7-5/8 Interest

Activity	Annual Recreation Value
Picnicking	52,400
Fishing	334,600
Swimming	741,800
Boating	750,000
Total	1,878,800

b. Cost Summary.

(1) First Costs - Tentative estimates of project costs which were developed for fill, dike and development costs for the construction of a 100 acre off-shore island in 10 feet and 30 feet of water are presented in Table B48. Cost estimates for two types of fill, slag, and dredge material, are presented. Development costs are based on a preliminary estimate for the development of a marina, picnic area, park, and a bathing beach.

(2) Annual Costs.

Estimated annual costs are based on a 50-year economic life and are presented in Table B49. Interest and amortization changes are based on an amortization factor of 0.07823 calculated at 7-5/8 percent.

Table B48 - Summary of Estimated First Costs

Depth of Water	10 Feet		30 Feet	
	Slag	Dredge Material	Slag	Dredge Material
	$	$	$	$
Cost of Fill	54,000,000	4,000,000	97,000,000	11,000,000
Dike Construction Cost	10,000,000	10,000,000	29,000,000	29,000,000
Development Costs	12,000,000	12,000,000	12,000,000	12,000,000
Total Construction Development Costs	54,000,000	26,000,000	138,000,000	52,000,000
Engineering and Design	3,240,000	1,560,000	8,280,000	3,120,000
Supervision and Administration	4,860,000	2,340,000	12,420,000	4,680,000
Contingencies	13,500,000	6,500,000	34,500,000	13,000,000
Total First Costs	75,600,000	36,400,000	193,200,000	72,800,000

Table B49 - Summary of Average Annual Costs

Depth of Water	10 Feet		30 Feet	
	Construction w/Slag Fill	Construction w/ Dredge Material	Construction w/Slag Fill	Construction w/ Dredge Material
Total First Costs	75,600,000	36,400,000	193,200,000	72,800,000
Interest (.07625)	5,765,000	2,776,000	14,732,000	5,551,000
Amortization (.00199)	150,000	72,000	384,000	145,000
Total Annual Costs	5,915,000	2,848,000	15,116,000	5,696,000

c. Preliminary Benefit-Cost Evaluation.

The estimated average annual costs and benefits, the net benefits, and the ratio of benefits to costs for each alternative construction scenario are

presented in Table B50. Based on the preliminary figures presented construction of an offshore island within Buffalo Harbor is not economically justified. However, due to the tentative and preliminary nature of the data utilized for this investigation further study of offshore island development should not be precluded solely on the basis of the preliminary benefit-cost relationship presented in this study.

Table B50 - Benefits and Costs Summary

Depth of Water	10 Feet		30 Feet	
	Construction w/ Slag Fill	Construction w/ Dredge Material	Construction w/ w/Slag Fill	Construction w/ Dredge Material
	$	$	$	$
Total Estimated Average Annual Benefits	1,878,800	1,878,800	1,878,800	1,878,800
Total Average Annual Costs	5,915,000	2,848,000	15,116,000	5,551,000
Net Benefits	-4,036,200	- 969,200	-13,237,200	-3,672,200
Benefit/Cost Ratio	0.32	0.66	0.12	0.34

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APPENDIX C
DESIGN

BUFFALO HARBOR, NY

STAGE II
PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

BUFFALO HARBOR, NY
PRELIMINARY FEASIBILITY REPORT
APPENDIX C
DESIGN

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BUFFALO HARBOR, NY
PRELIMINARY FEASIBILITY REPORT
APPENDIX C
DESIGN

C1. INTRODUCTION

This design appendix documents work performed in the preparation of the preliminary engineering designs, estimates, and related work for modifications to the Federal commercial navigation project at Buffalo, New York. The documented work is part of a "Preliminary Feasibility Report" for commercial navigation improvements to Buffalo Harbor being prepared by the Buffalo District, U.S. Army Corps of Engineers. The purpose of this appendix is to clearly document the engineering analysis and design developed for the proposed alternative navigational improvements. Prime emphasis has been placed on an alternative engineering solution that would enable alternative modes of transshipment, deeper draft, and safer navigation for vessels operating on the Great Lakes.

C2. FORMAT

This design appendix examines eight alternatives. The concept of each alternative is briefly described. The main project features are itemized and the engineering considerations for the alternative are explained.

C3. SCOPE

Designs are based on available information. No new field studies were performed.

C4. ALTERNATIVE IId

This alternative allows a ship with a maximum size of 639 feet X 72 feet with 22.5 feet of draft to navigate up the Buffalo River and Buffalo Ship Canal to primarily service the grain industry.

This alternative, as shown on Plate C-1, has the following main features and required tasks:

a. Deepening the North Entrance Channel to 29 feet below LWD in soft material and 30 feet below LWD in hard material.

b. Deepening the Federal channel in the Buffalo River to 25 feet below LWD in soft material and 26 feet below LWD in hard material for a distance of approximately 2.5 miles upstream from the mouth of the Buffalo River.

c. Deepening the Federal channel in the Buffalo Ship Canal to 25 feet below LWD in soft material and 26 feet below LWD in hard material for a distance of approximately 1.1 miles from the entrance.

d. Replacing 4,500 feet of existing bulkheads along the Buffalo River with Type I bulkheads (see Plate C-9).

e. Replacing 2,500 feet of existing bulkheads along the Buffalo Ship Canal with Type I bulkheads.

f. Providing protection to the Skyway Bridge piers with 800 feet of Type I bulkheads and 320 feet of fender system (Skyway Bridge spans across the Buffalo River and Buffalo Ship Canal).

g. Providing protection to the Michigan Avenue Bridge piers with 160 feet of Type I bulkhead and 160 feet of fender system (this bridge spans across the Buffalo River).

h. Demolishing two abandoned elevators and removing 1,370 feet of associated bulkhead.

i. Demolishing the Ganson Street Warehouse and 200 feet of associated bulkhead.

j. Relocating telephone, police, fire department cables, and a 16-inch diameter water line, that cross under the Buffalo Ship Canal.

k. Relocating a 4-foot diameter power conduit (containing 16 power cables) and a 16-inch diameter water line, that crosses under the Buffalo River.

Engineering Considerations - The decision to replace the existing bulkheads is based on their instability which is influenced by the top of rock elevation, the location of the existing Federal channel and the bulkhead supports. The proposed project depth of 26 feet below LWD (in hard material) is at elevation 542.6 (568.6 - 26.0) in the Buffalo River and Buffalo Ship Canal. The top of rock elevations predominately varied from above elevation 542.6 to elevation 529.0 for the reaches of Buffalo River and the Buffalo Ship Canal under consideration. Almost all of the existing bulkheads are estimated to be over 50 years old and information on many bulkheads is not available. The available information is primarily from permits for repair or renovation of existing structures requiring U.S. Army Corps of Engineers approval. Additional information was received in response to a questionnaire sent out to organizations in the area.

If an existing bulkhead is supported on rock or pinned to rock, excavating near the existing bulkhead would not undermine the existing bulkhead, and therefore would not need to be replaced. However, any bulkhead resting on or supported by soil would require more analysis. The stability of existing bulkheads supported by soil was analyzed by the "Free Earth Method" under existing conditions. All the bulkheads analyzed had a safety factor below 1.5 and therefore would need to be replaced. An analysis of typical bulkheads in the area is contained in later pages of this appendix.

Since the top of rock is usually within 10 feet of the project depth, all proposed sheetpile bulkheads are designed to be pinned at the bottom to the rock.

All bridge piers or abutments would be provided with sheet pile bulkheads and fender system for protection from ship collisions and bank erosion within those areas of navigational improvements in the Buffalo River and Buffalo Ship Canal.

The structures that are scheduled to be demolished have already been abandoned and are in disrepair. The existing bulkheads associated with these abandoned structures are considered unsafe. Any excavation nearby may be cause for collapse of the bulkheads into the river or canal. The weakening of the existing bulkheads would cause a more unsafe condition to the abandoned buildings. The cost of replacing the existing bulkheads range from $2,600 to $3,500 per foot. Instead of replacing the existing bulkheads to protect abandoned and dilapidated structures; demolishing the abandoned structures and cutting back the shoreline to a safe slope would remove any future costs.

A number of utilities that range from 22.3 to 30 feet below LWD, would be affected by deepening the Federal channel and need to be relocated. The depths of these utilities are considered approximate.

C5. ALTERNATIVE IIe

This alternative allows a ship with a maximum size of 639 feet X 72 feet with 22.5 feet of draft to navigate up the Buffalo River and Buffalo Ship Canal to primiarily service the grain industry. This alternative also allows a 1,000-foot ore carrier with a 25.5-foot draft to enter into the Lackawanna Canal and NFTA Slips.

This alternative as shown on Plate C-2, has the following main features and required tasks:

a. Removing 750 feet of breakwater at the south end of the south breakwater.

b. Constructing 1,500 feet of breakwater to the South Entrance Channel.

c. Move the north end light of the South Entrance Channel.

d. Deepen the Outer Harbor and the South Entrance Channel.

e. Deepen 2,000 feet of the Lackawanna Canal to 28-foot project depth (29 feet below LWD in hard material).

f. Include items (b) thru (k) inclusive of Alternative IId.

Engineering Considerations - All engineering considerations as described in Alternative IId are applicable to this alternative.

Details regarding South Channel Entrance improvements, such as removal of 750 feet of breakwater, construction of 1,500 feet of breakwater and moving the north end light, are described in the Coastal Appendix. Since the Outer Harbor is deepened, a vessel carrying iron ore could enter the Outer Harbor with a deeper draft (25.5 feet), unload a part of its cargo on NFTA property, and then proceed to Republic Steel Corporation or Hanna Furnace Company.

C6. ALTERNATIVE IIIf.

This alternative allows a 1,000-foot ore carrier with 25.5 feet of draft to enter the Allen Boat Company slip from the South Entrance Channel and unload its cargo. This alternative also allows a 1,000-foot ore carrier to safely enter the Lackawanna Canal.

This alternative, as shown on Plate C-3, has the following main features and required tasks:

a. South Entrance Channel improvements.

b. Deepen South Entrance Channel and a portion of the Outer Harbor as shown on Plate C-3.

c. Deepen 2,000 feet of the Lackawanna Canal to 28-foot project depth (29 feet below LWD in hard material).

d. Construct 2,600 feet of Type III bulkhead in the Allen Boat Company slip to 28 feet below LWD.

e. A shuttle vessel to load iron ore at the Allen Boat Company slip and deliver to Republic Steel Corporation or Hanna Furnace Company.

Engineering Considerations - The proposed bulkheads for the Allen Boat Company slip are pinned to rock as shown in Plate C-11 to provide stability. The limits of the ore pile are 36 feet from the proposed bulkhead to reduce surcharge loads on the bulkhead. See Plate C-10. See the Coastal Appendix for details of the South Entrance Channel improvements. Deepening the Lackawanna Canal a distance of 2,000 feet should not present any problems since the existing bulkheads are supported by rock and the depth of the existing channel needs to be increased approximately 1 to 2 feet. The increased depth of the Lackawanna Canal would not jeopardize the stability of the existing bulkheads.

C7. ALTERNATIVE IIIg

This alternative allows a 1,000-foot ore carrier with a 25.5-foot draft to enter the Allen Boat Company slip from the South Entrance Channel and unload its cargo of iron ore. The iron ore is delivered to Hanna Furnace Company and Republic Steel Corporation by rail. The ore carrier also has access to the Lackawanna Canal for direct delivery to Bethlehem Steel Corporation.

This alternative as shown on Plate C-4, has the following main features and required tasks:

a. South Entrance Channel improvements.

b. Include items (b) thru (d) inclusive, of Alternative IIIf.

c. Construct a rail spur to the Allen Boat Company slip.

d. Upgrade the railroad track as necessary to transship iron ore to Hanna Furnace Company and Republic Steel Corporation.

Engineering Considerations - There is a large amount of existing track in the general area. Alternative IIIg is designed to utilize this existing railroad track and have continuous transshipment operations throughout the year. Other engineering considerations are explained in Alternative IIIf.

C8. ALTERNATIVE IIIh

This alternative allows a 1,000-foot ore carrier with a 25.5-foot draft to enter the Outer Harbor from the South Entrance Channel and unload on Independent Cement property. The iron ore is delivered to Hanna Furnace Company and Republic Steel Corporation by rail. The ore carrier also has access to the Lackawanna Canal for direct delivery to Bethlehem Steel Corporation.

This alternative, as shown on Plate C-5, has the following main features and required tasks:

a. South Entrance Channel improvements.

b. Site work on Independent Cement Company property, to be done for iron ore storage.

c. Construct 2,800 feet of Type III bulkhead at Independent Cement Company (see Plates C-10 and C-11).

d. A new rail spur to the Outer Harbor through Independent Cement Company property.

e. Upgrade the railroad track as necessary to transship iron ore to Hanna Furnace and Republic Steel Corporation.

f. Deepen the Lackawanna Canal to 28 feet below LWD (29 feet in hard material).

Engineering Considerations - The location of the iron ore storage area was chosen to reduce the amount of dredging for maintenance. The present ground elevation is over 20 feet above the water level of the Outer Harbor at the Independent Cement Company property. The property is to be graded such that ground elevation is 10 feet above LWD. The excess soil is to be used to extend the shoreline north of the existing property of Independent Cement

Company for iron ore storage. The proposed Type III bulkheads are pinned to rock at the bottom for support. The route of the proposed rail spur is less congested than from the Allen Boat Company slip.

C9. ALTERNATIVE IIIi

This alternative allows a 1,000-foot ore carrier with a 25.5-foot draft to enter the Outer Harbor from the South Entrance Channel and unload on Independent Cement property. Iron ore is delivered to Republic Steel Corporation and Hanna Furnace Company by shuttle vessel.

The ore carrier also has access to the Lackawanna Canal for direct delivery to Bethlehem Steel Corporation.

This alternative, as shown on Plate C-6, has the following main features and required tasks:

a. South Entrance Channel improvements.

b. Site work on Independent Cement Company property, to be done for iron ore storage.

c. Construct 2,800 feet of Type III bulkhead at Independent Cement Company (see Plates C-10 and C-11).

d. Deepen the Lackawanna Canal to 28 feet below LWD (29 feet in hard material).

e. Provide shuttle vessel to transport iron ore to Republic Steel Corporation.

Engineering Considerations - Those considerations pertaining to the location of the iron ore pile, bulkheads, and site work are described in Para C8. The shuttle vessel operation is assumed to be shut down during the winter season and it is assumed that iron ore storage is available at Hanna Furnace Company and Republic Steel Corporation to last through the winter.

C10. ALTERNATIVE IVa

This alternative allows a 1,000-foot ore carrier with a 25.5-foot draft to enter the Outer Harbor from the South Entrance channel and into the Lackawanna Canal for direct delivery to Bethlehem Steel Corporation. A vessel with 639 feet X 72 feet maximum size and a 25.5-foot draft can unload on NFTA property till its draft is 19.5 feet and then proceed up the Buffalo River to Republic Steel Corporation to deliver the remainder of its load. Vessels presently using the Union Canal can deliver iron ore by navigating up the Union Canal to Hanna Furnace Company, after unloading some of their iron ore on NFTA property at the Outer Harbor.

This alternative, as shown on Plate C-7, has the following main features and required tasks:

a. South Entrance Channel improvements.

b. Deepen the Outer Harbor as shown.

c. Deepen the Lackawanna Canal to 28 feet below LWD (29 feet in hard material).

Engineering Considerations - Alternative IVa enhances existing operations for 1,000-foot vessels and for vessels that lighten their load on NFTA property along the Outer Harbor. Improvements to the South Entrance Channel result in safer navigation for the 1,000-foot ore carriers. Deepening the Outer Harbor allows existing vessels (639 feet X 72 feet maximum size) to carry more iron ore because of the deeper draft.

The 1,000-foot ore carriers go up the Lackwanna Canal and unload all their iron ore at Bethlehem Steel Corporation.

At the present time, the iron ore stored on NFTA property is trucked to Republic Steel Corporation or Hanna Furnace Company. Since the present quantities are not large the trucking operations are assumed not to deteriorate the existing roads.

The trucking for this alternative (approximately 25,000 tons per year) would not change the original assumption with regard to road deterioration.

C11. ALTERNATIVE IVb

This alternative allows a 1,000-foot ore carrier with a 25.5-foot draft to enter the Outer Harbor from the South Entrance Channel and into the Lackawanna Canal for direct delivery to Bethlehem Steel Corp. A vessel (639 feet X 72 feet maximum size) with a 24.5-foot draft (1-foot deeper than presently handled) can unload more iron ore on NFTA property.

This alternative, as shown on Plate C-8, has the following main features and required tasks:

a. South Entrance Channel improvements.

b. Deepen the Lackawanna Canal to 28 feet below LWD (29 feet in hard material).

Engineering Considerations - The engineering considerations are the same as those in Alternative IVa.

C12. THE USEFUL LIFE OF EXISTING BULKHEADS

Assumptions - The first assumption is that the date shown precedes the actual construction of the bulkhead by no more than one year. The second

assumption is that the total useful life of all the bulkheads is fifty (50) years. The linear feet of bulkhead for each permit is also tabulated in order that a weighted average remaining useful life for the bulkheads in each reach can be determined.

Table C1 - Section No. 10 (Buffalo Ship Canal)

Permit Number	Year Constructed	Remaining Useful Life (Yrs. after 1990)	Length (Feet)	Remarks
976072001	1977	37	90	Replacement
		Subtotal	90	Average Remaining Life = 37 years

Remarks - The total amount of bulkhead replacement for Section 10 is 2,500 feet. Although it cannot be proven at the present time, it is felt that this permit substantially overstates the average remaining life of the bulkheads on the Buffalo Ship Canal.

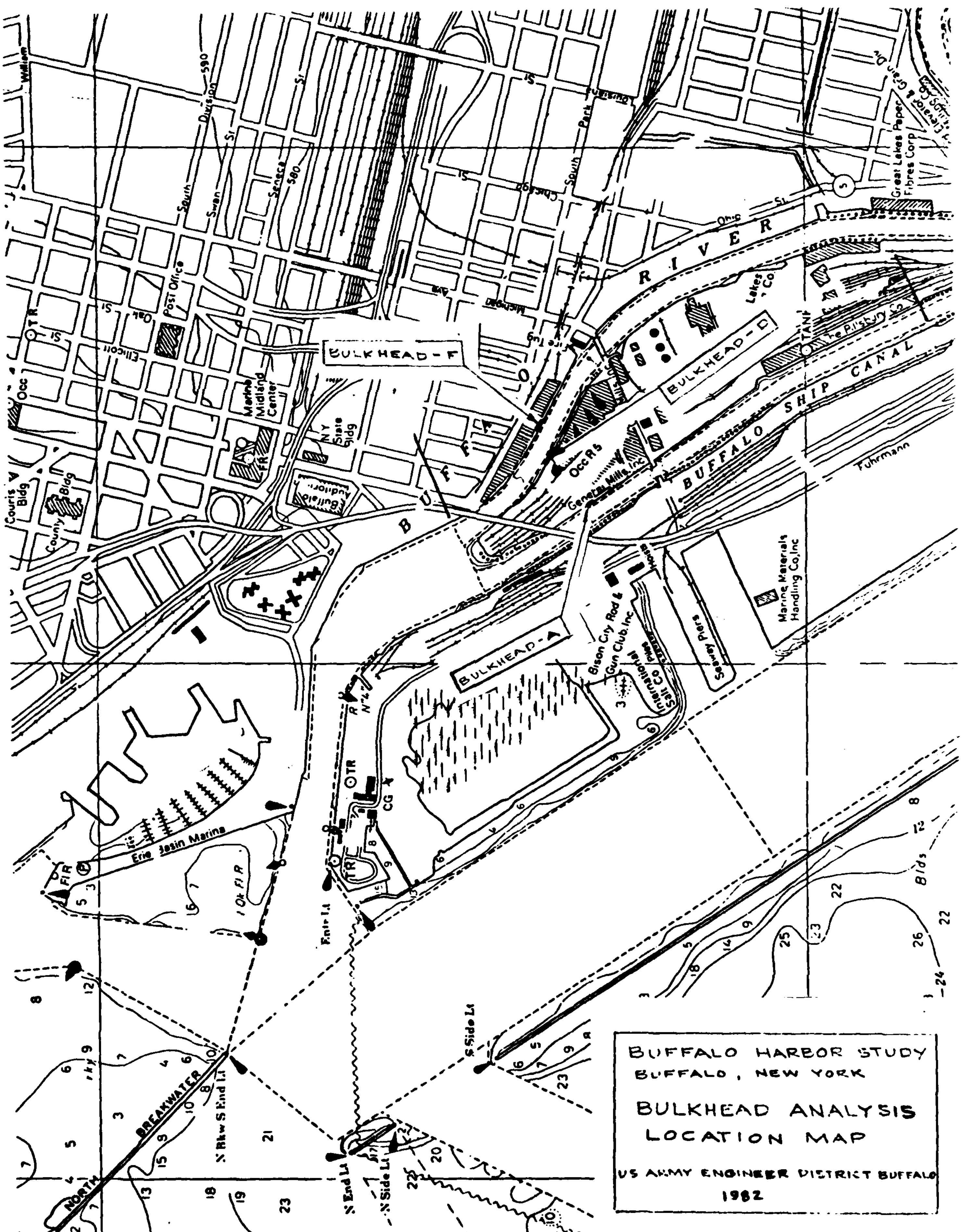
Table C2 - Section No. 11

Permit No.	Year	Remaining Useful Life (Years after 1990)	Length (Feet)	Remarks
974071002	1974	34	65	
953071002	1953	13	377	Cellular Bulkhead
952071004	1953	13	276	
951071001	1952	12	120	Timber Bulkhead
959071005	1959	19	45	
943071002	1944	4	80	
959071001	1959	19	250	Reconstruction
959071003	1959	19	434	Includes One Cell
959071002	1959	19	128	Crib Wall
Subtotal			1,775	Average Remaining Life = 13 Years

Remarks - The total amount of bulkhead that needs to be replaced in Section 11 is 4,500 feet. Although it can not be proven at this time, it is felt that these permits overstate the average remaining life of the bulkheads.

Section No.	Average Remaining Life (Years after 1990)	Location	Average Remaining Life
10	37	Buffalo Ship Canal	14 Years (1)
11	13	Buffalo River	14 Years (1)

(1) This figure represents a weighted average for Sections 10 and 11. It is felt that 14 years is an overstatement of the useful life of the bulkheads. This translates into a conservative estimate of the benefits associated with advanced replacements.

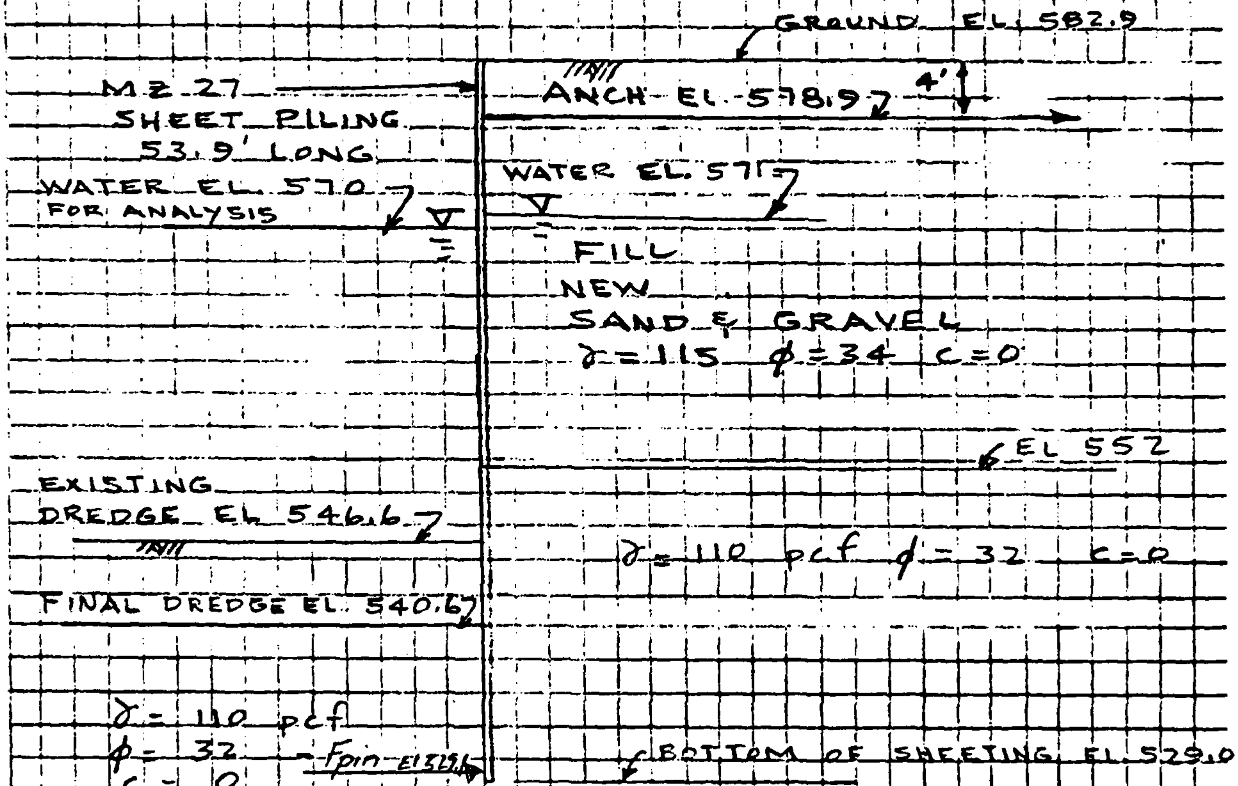

BULKHEAD-F
BULKHEAD-D
BULKHEAD-A
RIVER
BUFFALO SHIP CANAL
NORTH BREAKWATER
Erie Basin Marina
Post Office
Marine Midland Center
NY State Bldg
Buffalo Auditorium
County Bldg
General Mills, Inc
The Pillsbury Co.
Great Lakes Paper Fibres Corp
Marine Materials Handling Co, Inc
Seaway Piers
Bison City Rod & Gun Club, Inc
International Salt Co
Fuhrmann
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
BULKHEAD ANALYSIS
LOCATION MAP
US ARMY ENGINEER DISTRICT BUFFALO
1982

JOB NO. AAK010211000000

Subject: BUFFALO HARBOR STUDY

Computation of: ANALYSIS OF BULKHEAD - A

Computed by: JKK Checked by: ____ Date: DEC 4/81



MODULUS OF ELASTICITY $= 29 \times 10^6$ lb/in^2

MOMENT OF INERTIA $30.2 \times 6 = 181.2$ in^4

$Z = I/c$

$Z = 30.2$ in^3/ft $30.2 = I/6''$

```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/04/81                           TIME: 10:06:40

1. INPUT DATA

1.A.--HEADING

BUFFALO HARBOR STUDY   BULKHEAD A
FILENAME=BUFF10    DREDGELINE=546.6


1.B.--WALL TYPE, MODE, METHOD
    ANCHORED WALL ANALYSIS BY FREE EARTH METHOD


1.C.--WALL DESCRIPTION
    TOP OF WALL ELEVATION     =  582.90 (FT)
    ANCHOR ELEVATION          =  578.90 (FT)
    BOTTOM OF WALL ELEVATION  =  529.00 (FT)
    MODULUS OF ELASTICITY     = 2.900E+07 (PSI)
    MOMENT OF INERTIA         = 1.812E+02 (IN**4)


1.D.--RIGHT SIDE SOIL DESCRIPTION
    NUMBER OF RIGHT SIDE SURFACE POINTS =  1
    NUMBER OF RIGHT SIDE SOIL LAYERS    =  2


    RIGHT SIDE SURFACE POINT COORDINATES
    POINT      ELEVATION      X-COORD
     NO.         (FT)           (FT)
      1         582.90          0.00
```

RIGHT SIDE SOIL LAYER DATA

LAYER NO.	UNIT WEIGHT (PCF)	INTERNAL FRICTION ANGLE (DEG)	COHESION (PSF)	WALL FRICTION ANGLE (DEG)	BOTTOM ELEV AT WALL (FT)	BOTTOM SLOPE (FT/FT)
1	115.00	34.00	0.00	0.00	552.00	1:0.0
2	110.00	32.00	0.00	0.00		

1.E.--LEFT SIDE SOIL DESCRIPTION

NUMBER OF LEFT SIDE SURFACE POINTS = 1
NUMBER OF LEFT SIDE SOIL LAYERS = 1

LEFT SIDE SURFACE POINT COORDINATES

POINT NO.	ELEVATION (FT)	X-COORD (FT)
1	546.60	0.00

LEFT SIDE SOIL LAYER DATA

LAYER NO.	UNIT WEIGHT (PCF)	INTERNAL FRICTION ANGLE (DEG)	COHESION (PSF)	WALL FRICTION ANGLE (DEG)	BOTTOM ELEV AT WALL (FT)	BOTTOM SLOPE (FT/FT)
1	110.00	32.00	0.00	0.00		

1.F.--WATER DATA

RIGHT SIDE ELEVATION = 571.00 (FT)
LEFT SIDE ELEVATION = 570.00 (FT)
WATER UNIT WEIGHT = 62.40 (PCF)
SEEPAGE GRADIENT = 0.00 (FT/FT)

BULKHEAD A
FILE BUFF 10

```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/04/81                          TIME: 10:07:37

2. RESULTS

2.A.--HEADING

BUFFALO HARBOR STUDY   BULKHEAD A
FILENAME=BUFF10    DREDGELINE=546.6


2.B.--SUMMARY OF RESULTS FOR ANCHORED   WALL ANALYSIS

    SOIL PRESSURES DETERMINED BY COULOMB
    COEFFICIENTS AND THEORY OF ELASTICITY
    EQUATIONS FOR SURCHARGE LOADS

                FACTOR OF     MAXIMUM          MAXIMUM     ANCHOR
  METHOD         SAFETY    BENDING MOMENT    DEFLECTION    FORCE
                              (LB-FT)           (IN)        (LB)
FREE EARTH :      .99        152091.         1.21E+01     11057.


DO YOU WANT COMPLETE RESULTS OUTPUT?
ENTER 'YES' OR 'NO'
I>_
```

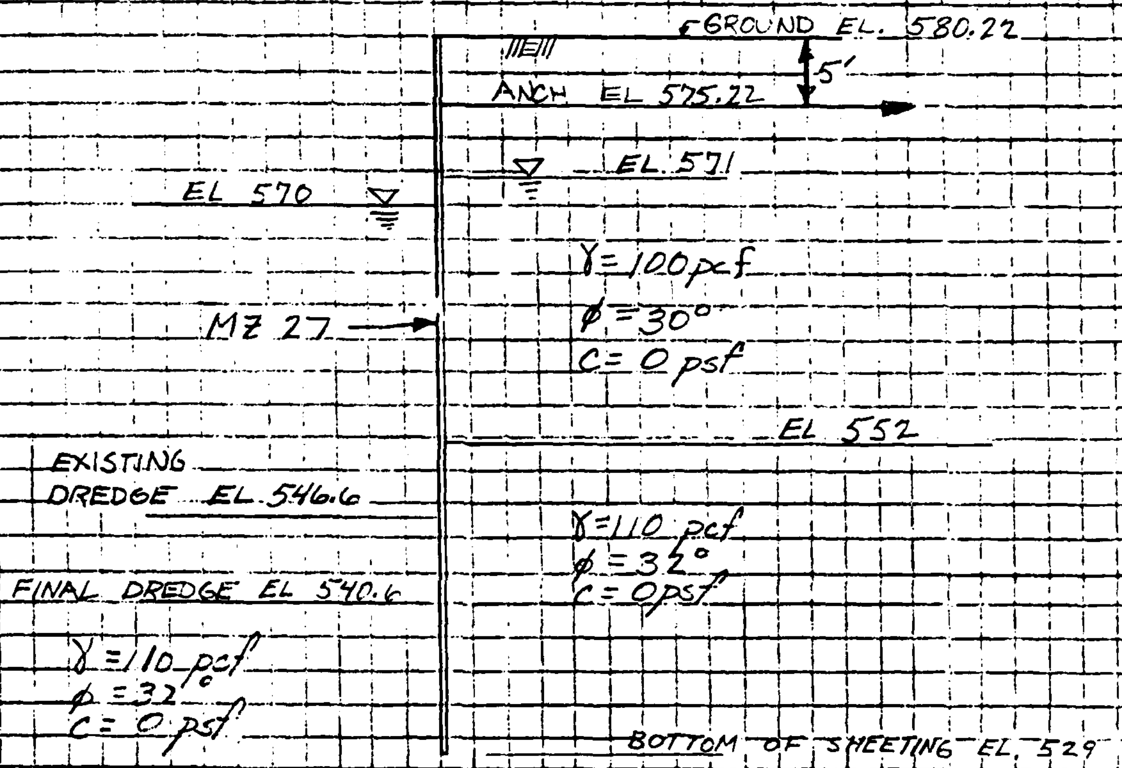
AAK010211000000

Page ____ of ____ pages.

Subject: BUFFALO HARBOR STUDY

Computation of: ANALYSIS OF BULKHEAD - D

Computed by: FJL   Checked by: ________   Date: DEC. 8 1981



$E = 29 \times 10^6$ psi

$I = 181.2$ in^4

```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/08/81                         TIME: 05:46:37

1. INPUT DATA

1.A.--HEADING

BUFFALO HARBOR STUDY  BULKHEAD D
FILENAME*BUFF11    DREDGELINE*546.6


1.B.--WALL TYPE, MODE, METHOD
    ANCHORED WALL ANALYSIS BY FREE EARTH METHOD


1.C.--WALL DESCRIPTION
    TOP OF WALL ELEVATION     =  580.22 (FT)
    ANCHOR ELEVATION          =  575.22 (FT)
    BOTTOM OF WALL ELEVATION  =  529.00 (FT)
    MODULUS OF ELASTICITY     = 2.900E+07 (PSI)
    MOMENT OF INERTIA         = 1.812E+02 (IN**4)


1.D.--RIGHT SIDE SOIL DESCRIPTION
    NUMBER OF RIGHT SIDE SURFACE POINTS =  1
    NUMBER OF RIGHT SIDE SOIL LAYERS    =  2


    RIGHT SIDE SURFACE POINT COORDINATES
    POINT      ELEVATION     X-COORD
     NO.          (FT)         (FT)
      1         580.22         0.00
```

RIGHT SIDE SOIL LAYER DATA

LAYER NO.	UNIT WEIGHT (PCF)	INTERNAL FRICTION ANGLE (DEG)	COHESION (PSF)	WALL FRICTION ANGLE (DEG)	BOTTOM ELEV AT WALL (FT)	BOTTOM SLOPE (FT/FT)
1	100.00	30.00	0.00	0.00	552.00	1:0.[illegible]
2	110.00	32.00	0.00	0.00		

1.E.--LEFT SIDE SOIL DESCRIPTION

NUMBER OF LEFT SIDE SURFACE POINTS = 1
NUMBER OF LEFT SIDE SOIL LAYERS = 1

LEFT SIDE SURFACE POINT COORDINATES

POINT NO.	ELEVATION (FT)	X-COORD (FT)
1	546.60	0.00

LEFT SIDE SOIL LAYER DATA

LAYER NO.	UNIT WEIGHT (PCF)	INTERNAL FRICTION ANGLE (DEG)	COHESION (PSF)	WALL FRICTION ANGLE (DEG)	BOTTOM ELEV AT WALL (FT)	BOTTOM SLOPE (FT/FT)
1	110.00	32.00	0.00	0.00		

1.F.--WATER DATA

RIGHT SIDE ELEVATION = 571.00 (FT)
LEFT SIDE ELEVATION = 570.00 (FT)
WATER UNIT WEIGHT = 62.40 (PCF)
SEEPAGE GRADIENT = 0.00 (FT/FT)

```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/08/81                          TIME: 05:47:29

2. RESULTS

2.A.--HEADING

BUFFALO HARBOR STUDY  BULKHEAD D
FILENAME=BUFF11    DREDGELINE=546.6


2.B.--SUMMARY OF RESULTS FOR ANCHORED   WALL ANALYSIS


      SOIL PRESSURES DETERMINED BY COULOMB
      COEFFICIENTS AND THEORY OF ELASTICITY
      EQUATIONS FOR SURCHARGE LOADS

                FACTOR OF      MAXIMUM        MAXIMUM     ANCHOR
 METHOD          SAFETY     BENDING MOMENT   DEFLECTION    FORCE
                               (LB-FT)         (IN)        (LB)
FREE EARTH :      1.15         119393.       8.06E+00     10508.


   DO YOU WANT COMPLETE RESULTS OUTPUT?
   ENTER 'YES' OR 'NO'
I>
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```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/08/81                          TIME: 05:52:33

2. RESULTS

2.A.--HEADING

BUFFALO HARBOR STUDY  BULKHEAD D
FILENAME=BUFF12   DREDLINE=540.6


2.B.--SUMMARY OF RESULTS FOR ANCHORED   WALL ANALYSIS


    SOIL PRESSURES DETERMINED BY COULOMB
    COEFFICIENTS AND THEORY OF ELASTICITY
    EQUATIONS FOR SURCHARGE LOADS


                FACTOR OF       MAXIMUM          MAXIMUM     ANCHOR
 METHOD          SAFETY     BENDING MOMENT     DEFLECTION    FORCE
                               (LB-FT)            (IN)        (LB)
FREE EARTH :       .79         98447.          6.86E+00      8057.


DO YOU WANT COMPLETE RESULTS OUTPUT?
ENTER 'YES' OR 'NO'
I>_
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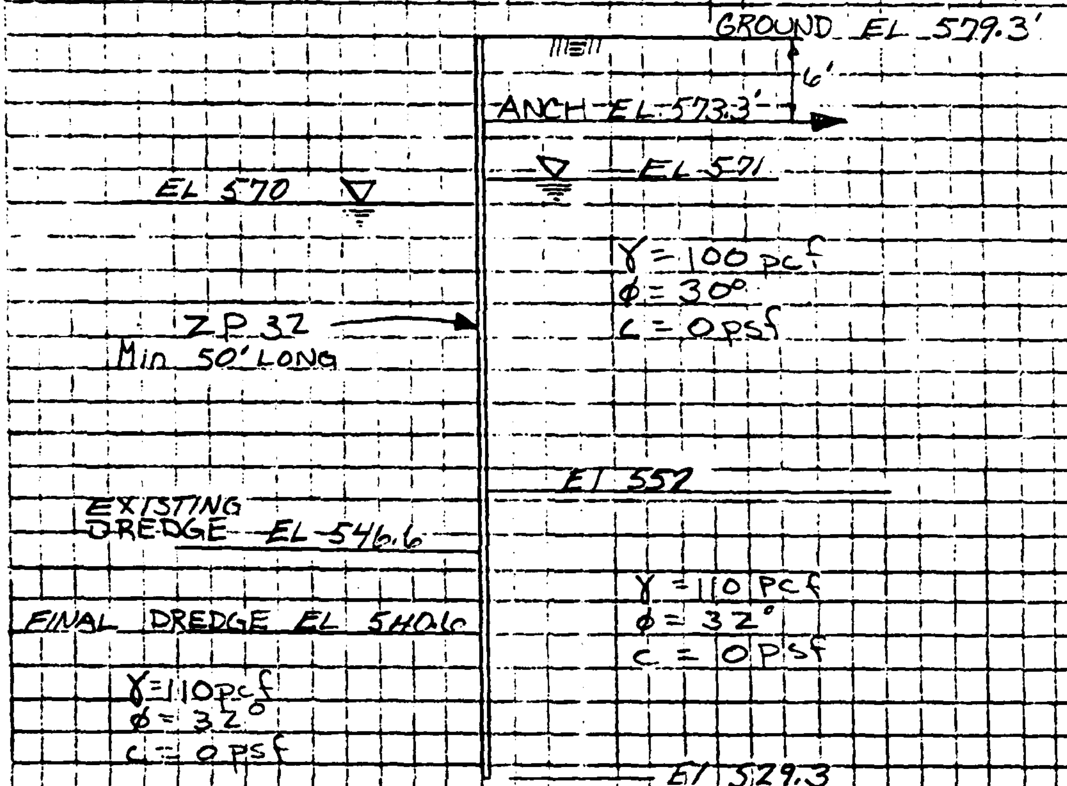
AAK010211000000

Page ___ of ___ pages.

Subject: BUFFALO HARBOR STUDY

Computation of: ANALYSIS OF BULKHEAD - E

Computed by: ETL   Checked by: ______   Date: DEC 8, 1981



$E = 29 \times 10^6$ psi

$I = 220.4$

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PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/08/81                              TIME: 09:53:51

1. INPUT DATA

1.A.--HEADING

BUFFALO HARBOR STUDY  BULKHEAD F
FILENAME=BUFF13   DREDGELINE=546.6


1.B.--WALL TYPE, MODE, METHOD
    ANCHORED WALL ANALYSIS BY FREE EARTH METHOD


1.C.--WALL DESCRIPTION
    TOP OF WALL ELEVATION    =  579.30 (FT)
    ANCHOR ELEVATION         =  573.30 (FT)
    BOTTOM OF WALL ELEVATION =  529.30 (FT)
    MODULUS OF ELASTICITY    = 2.900E+07 (PSI)
    MOMENT OF INERTIA        = 2.204E+02 (IN**4)


1.D.--RIGHT SIDE SOIL DESCRIPTION
    NUMBER OF RIGHT SIDE SURFACE POINTS =  1
    NUMBER OF RIGHT SIDE SOIL LAYERS    =  2


    RIGHT SIDE SURFACE POINT COORDINATES
    POINT      ELEVATION      X-COORD
     NO.         (FT)          (FT)
      1         579.30         0.00
```

RIGHT SIDE SOIL LAYER DATA

LAYER NO.	UNIT WEIGHT (PCF)	INTERNAL FRICTION ANGLE (DEG)	COHESION (PSF)	WALL FRICTION ANGLE (DEG)	BOTTOM ELEV AT WALL (FT)	BOTTOM SLOPE (FT/FT)
1	100.00	30.00	0.00	0.00	552.00	1:0.0
2	110.00	32.00	0.00	0.00		

1.E.--LEFT SIDE SOIL DESCRIPTION

NUMBER OF LEFT SIDE SURFACE POINTS = 1
NUMBER OF LEFT SIDE SOIL LAYERS = 1

LEFT SIDE SURFACE POINT COORDINATES

POINT NO.	ELEVATION (FT)	X-COORD (FT)
1	546.60	0.00

LEFT SIDE SOIL LAYER DATA

LAYER NO.	UNIT WEIGHT (PCF)	INTERNAL FRICTION ANGLE (DEG)	COHESION (PSF)	WALL FRICTION ANGLE (DEG)	BOTTOM ELEV AT WALL (FT)	BOTTOM SLOPE (FT/FT)
1	110.00	32.00	0.00	0.00		

1.F. -WATER DATA

RIGHT SIDE ELEVATION = 571.00 (FT)
LEFT SIDE ELEVATION = 570.00 (FT)
WATER UNIT WEIGHT = 62.40 (PCF)
SEEPAGE GRADIENT = 0.00 (FT/FT)

```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/08/81                        TIME: 09:58:34

2. RESULTS

2.A.--HEADING

BUFFALO HARBOR STUDY      BULKHEAD F
DREDGELINE=540.6


2.B.--SUMMARY OF RESULTS FOR ANCHORED   WALL ANALYSIS

     SOIL PRESSURES DETERMINED BY COULOMB
     COEFFICIENTS AND THEORY OF ELASTICITY
     EQUATIONS FOR SURCHARGE LOADS

              FACTOR OF      MAXIMUM          MAXIMUM       ANCHOR
  METHOD       SAFETY     BENDING MOMENT     DEFLECTION      FORCE
                             (LB-FT)            (IN)          (LB)
FREE EARTH :     .80         86822.          4.51E+00       7867.


    DO YOU WANT COMPLETE RESULTS OUTPUT?
    ENTER 'YES' OR 'NO'
I>_
```

```
PROGRAM SHTWAL - DESIGN/ANALYSIS OF ANCHORED
OR CANTILEVER SHEET PILE WALLS BY CLASSICAL METHODS
DATE: 12/08/81                          TIME: 09:54:47

2. RESULTS

2.A.--HEADING

BUFFALO HARBOR STUDY  BULKHEAD F
FILENAME=BUFF13   DREDGELINE=546.6


2.B.--SUMMARY OF RESULTS FOR ANCHORED   WALL ANALYSIS

     SOIL PRESSURES DETERMINED BY COULOMB
     COEFFICIENTS AND THEORY OF ELASTICITY
     EQUATIONS FOR SURCHARGE LOADS

                FACTOR OF       MAXIMUM          MAXIMUM      ANCHOR
METHOD           SAFETY     BENDING MOMENT     DEFLECTION     FORCE
                                (LB-FT)           (IN)         (LB)
FREE EARTH :      1.18         104587.          5.24E+00     10291.


  DO YOU WANT COMPLETE RESULTS OUTPUT?
  ENTER 'YES' OR 'NO'
I>_
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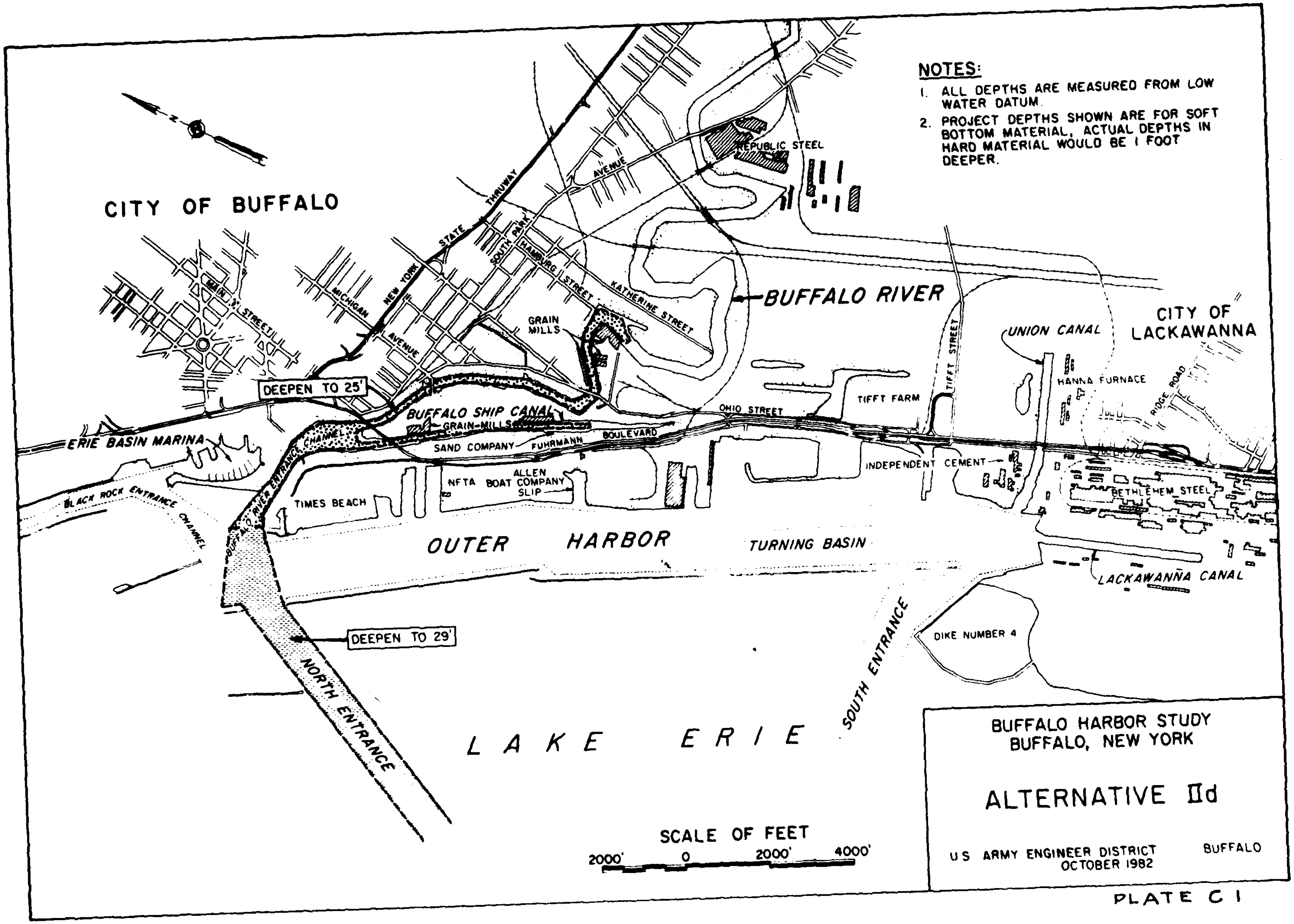
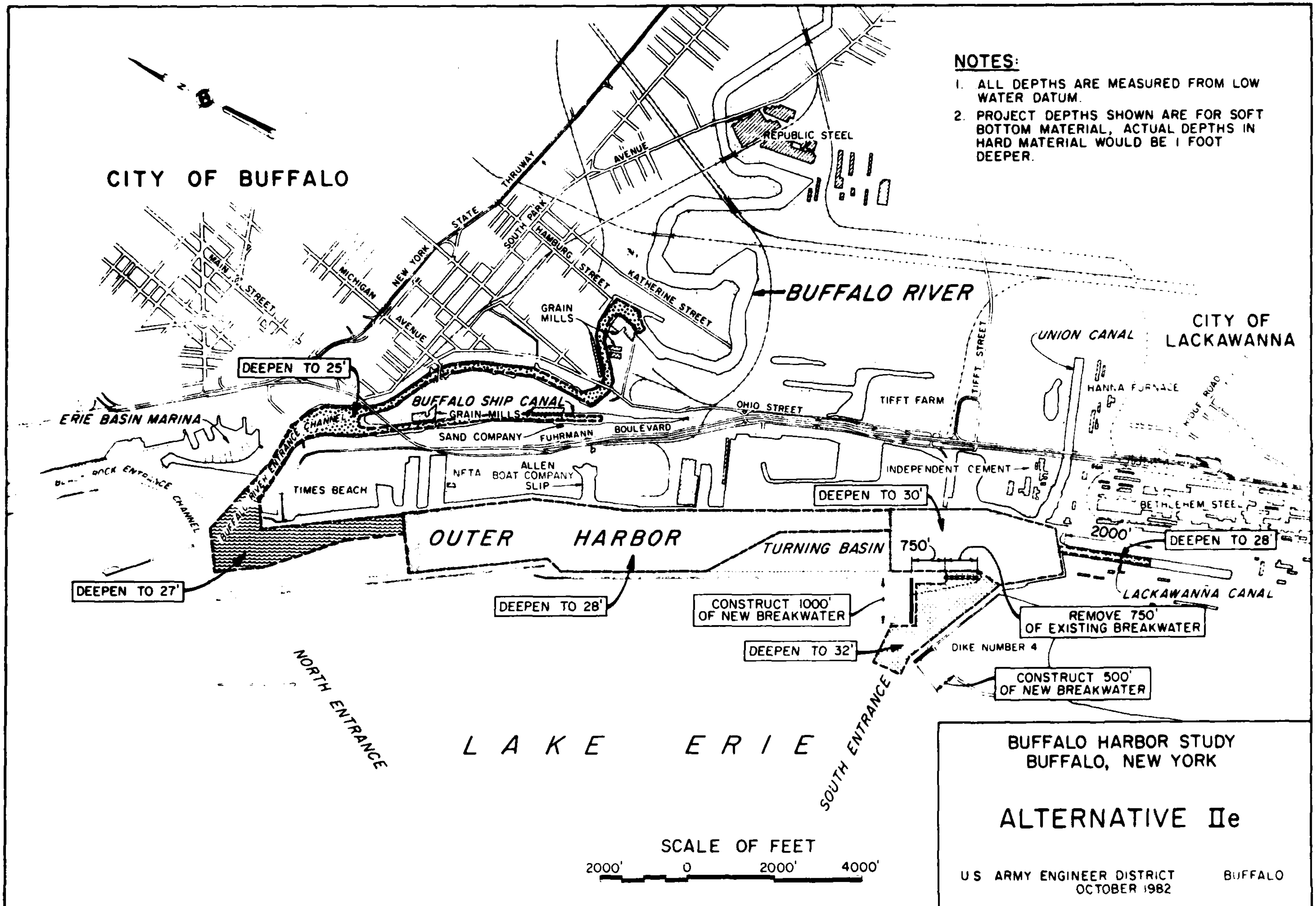

NOTES:
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.
CITY OF BUFFALO
CITY OF LACKAWANNA
BUFFALO RIVER
REPUBLIC STEEL
AVENUE
STATE THRUWAY
NEW YORK
SOUTH PARK
HAMBURG STREET
KATHERINE STREET
MICHIGAN AVENUE
MAIN ST. STREET
GRAIN MILLS
DEEPEN TO 25'
BUFFALO SHIP CANAL
GRAIN-MILLS
SAND COMPANY
FUHRMANN
BOULEVARD
OHIO STREET
TIFFT FARM
TIFFT STREET
UNION CANAL
HANNA FURNACE
RIDGE ROAD
INDEPENDENT CEMENT
BETHLEHEM STEEL
ERIE BASIN MARINA
BLACK ROCK ENTRANCE CHANNEL
BUFFALO RIVER ENTRANCE CHANNEL
NFTA
ALLEN BOAT COMPANY SLIP
TIMES BEACH
OUTER HARBOR
TURNING BASIN
LACKAWANNA CANAL
DIKE NUMBER 4
DEEPEN TO 29'
NORTH ENTRANCE
SOUTH ENTRANCE
LAKE ERIE
SCALE OF FEET
2000' 0 2000' 4000'
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
ALTERNATIVE IId
U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C 1



NOTES:

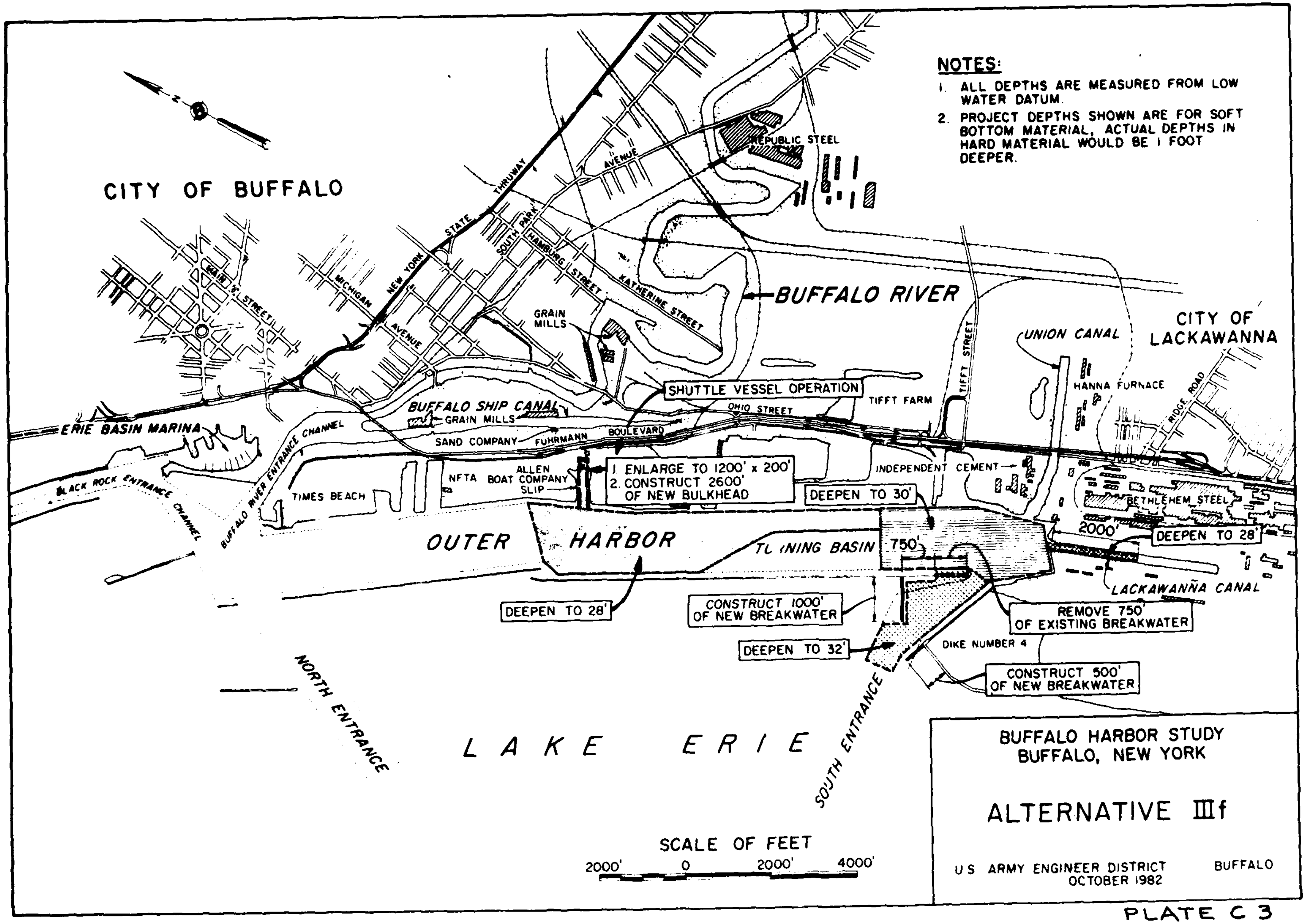
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

ALTERNATIVE IIe

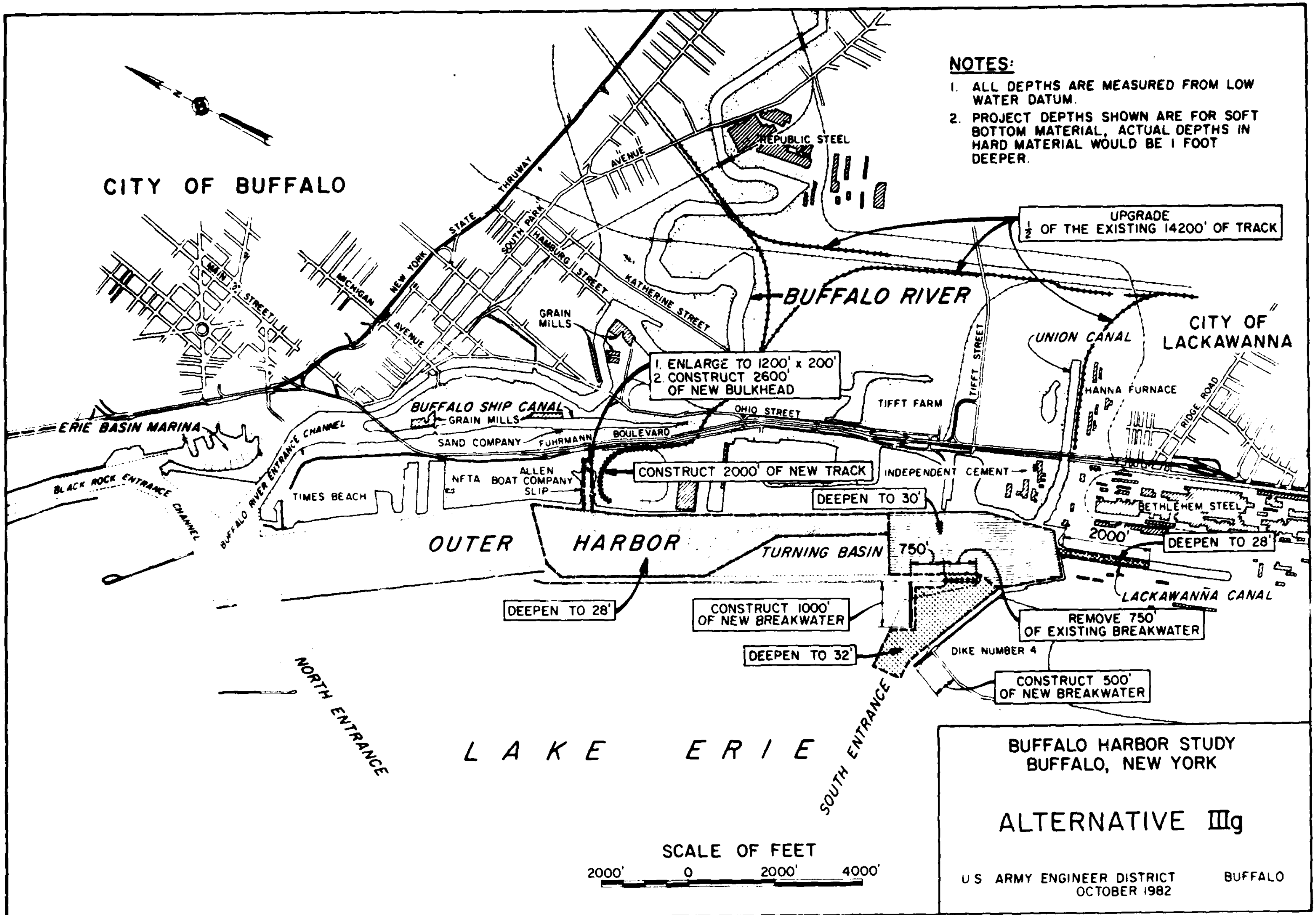
US ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C 2



NOTES:
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.
CITY OF BUFFALO
CITY OF LACKAWANNA
BUFFALO RIVER
REPUBLIC STEEL
GRAIN MILLS
UNION CANAL
HANNA FURNACE
RIDGE ROAD
TIFFT STREET
TIFFT FARM
SHUTTLE VESSEL OPERATION
OHIO STREET
BUFFALO SHIP CANAL
GRAIN MILLS
SAND COMPANY
FUHRMANN
BOULEVARD
ERIE BASIN MARINA
BLACK ROCK ENTRANCE CHANNEL
BUFFALO RIVER ENTRANCE CHANNEL
TIMES BEACH
NFTA
ALLEN BOAT COMPANY SLIP
1. ENLARGE TO 1200' x 200'
2. CONSTRUCT 2600' OF NEW BULKHEAD
INDEPENDENT CEMENT
DEEPEN TO 30'
BETHLEHEM STEEL
2000'
DEEPEN TO 28'
OUTER HARBOR
TURNING BASIN
750'
LACKAWANNA CANAL
DEEPEN TO 28'
CONSTRUCT 1000' OF NEW BREAKWATER
REMOVE 750' OF EXISTING BREAKWATER
DEEPEN TO 32'
DIKE NUMBER 4
CONSTRUCT 500' OF NEW BREAKWATER
NORTH ENTRANCE
SOUTH ENTRANCE
LAKE ERIE
SCALE OF FEET
2000' 0 2000' 4000'
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
ALTERNATIVE IIIf
U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C 3

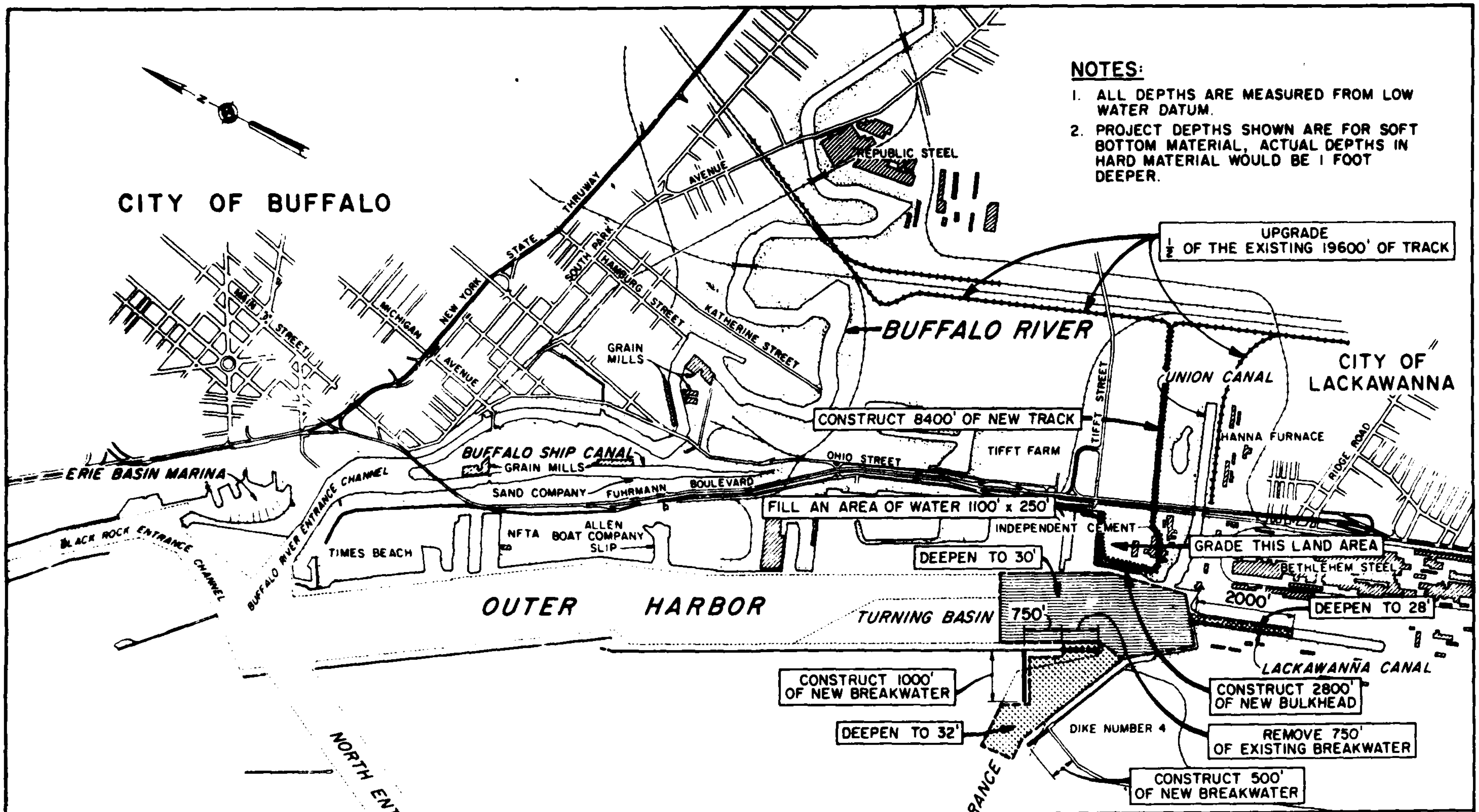


BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

ALTERNATIVE IIIg

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C 4

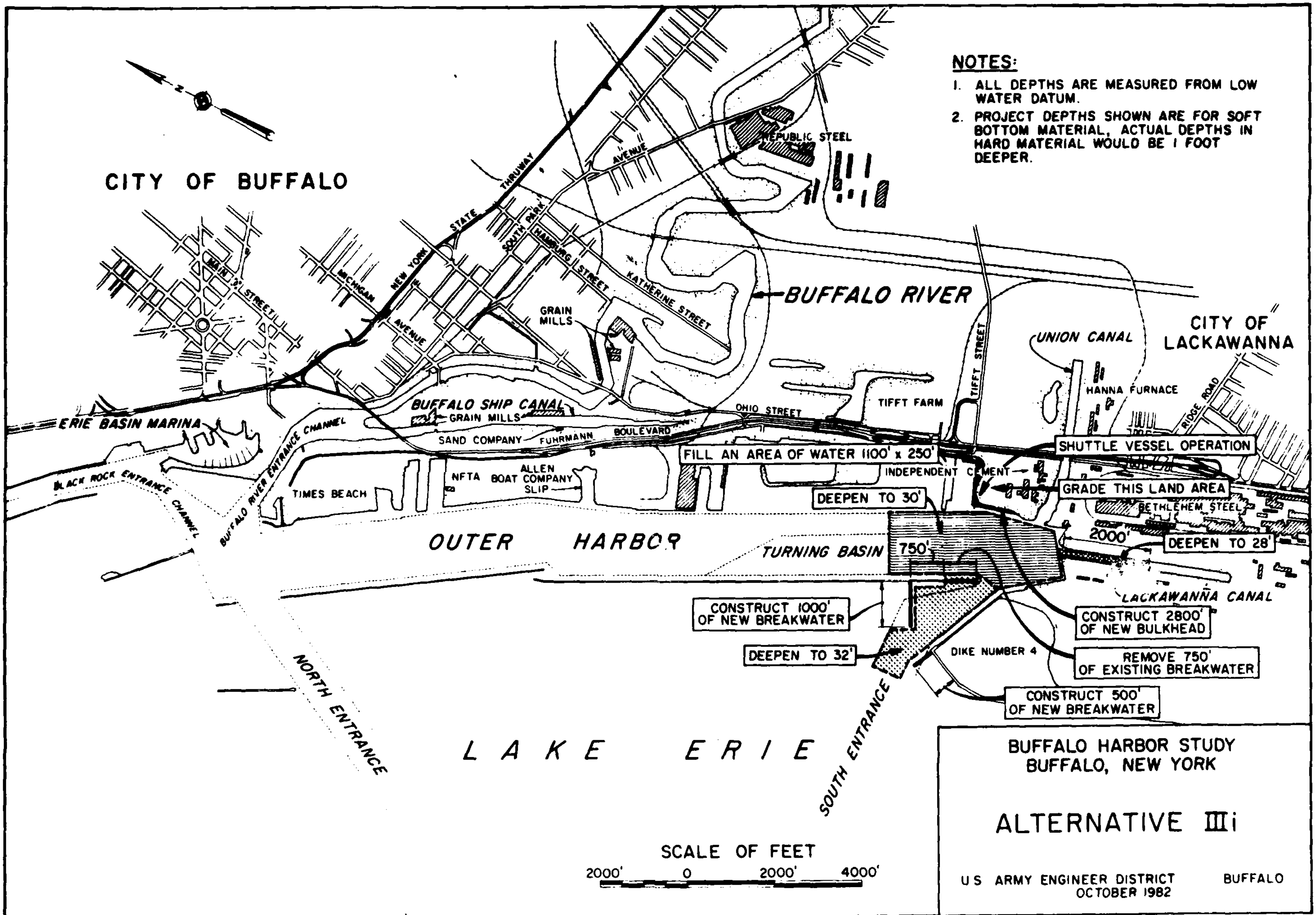


BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

ALTERNATIVE IIIh

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C 5



NOTES:

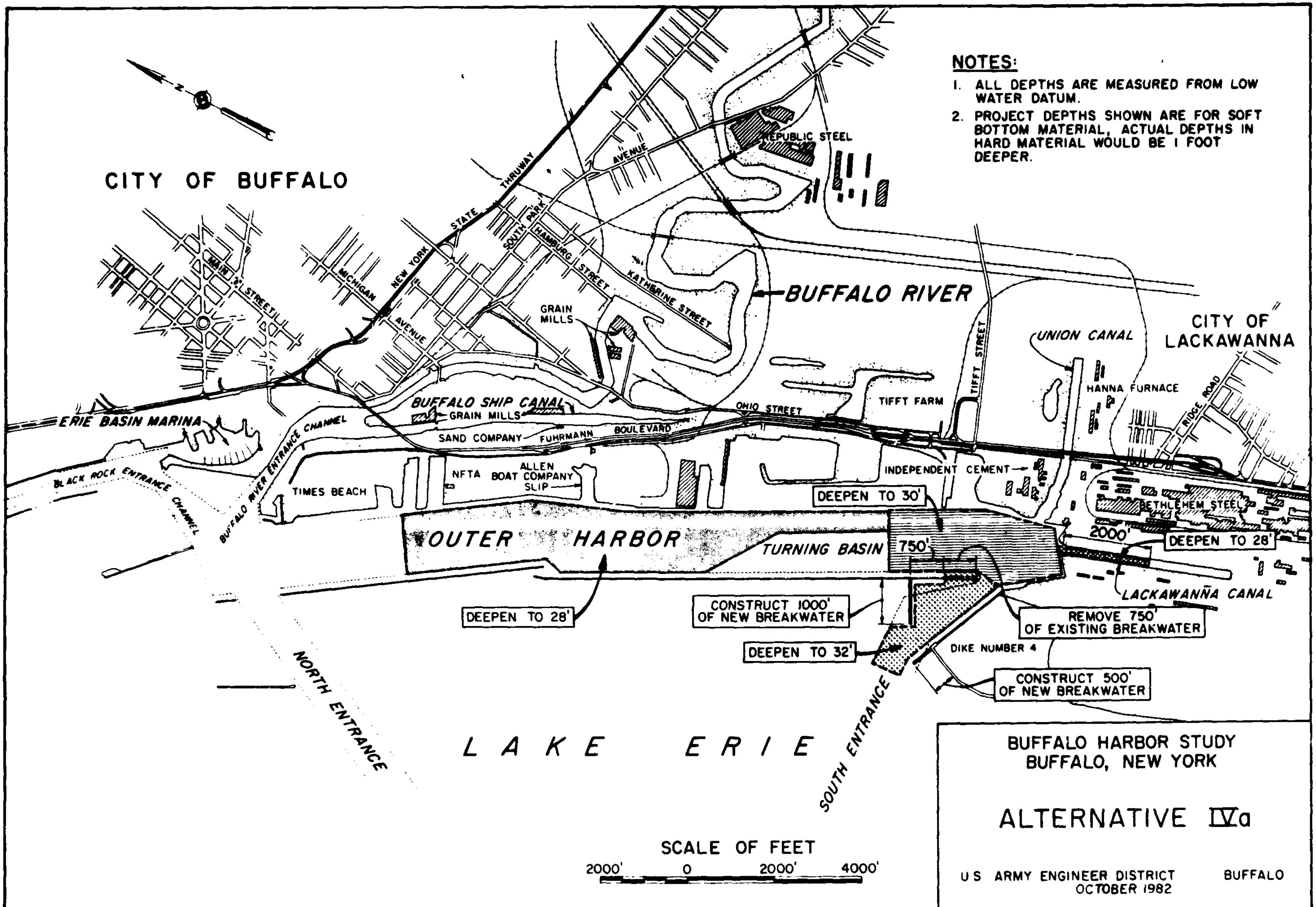
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

ALTERNATIVE IIIi

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C6



NOTES:

1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE I FOOT DEEPER.

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

ALTERNATIVE IVa

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C7

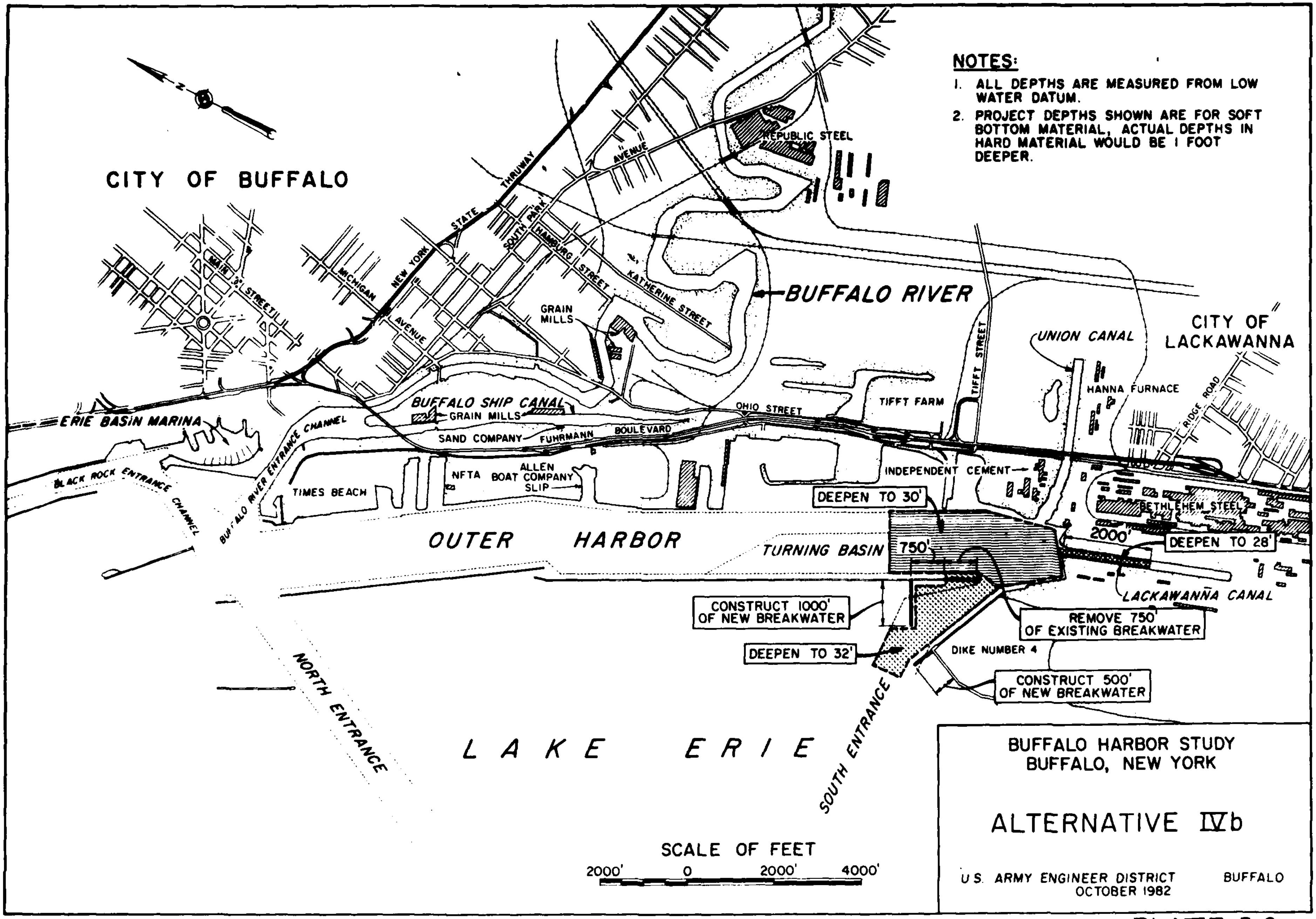
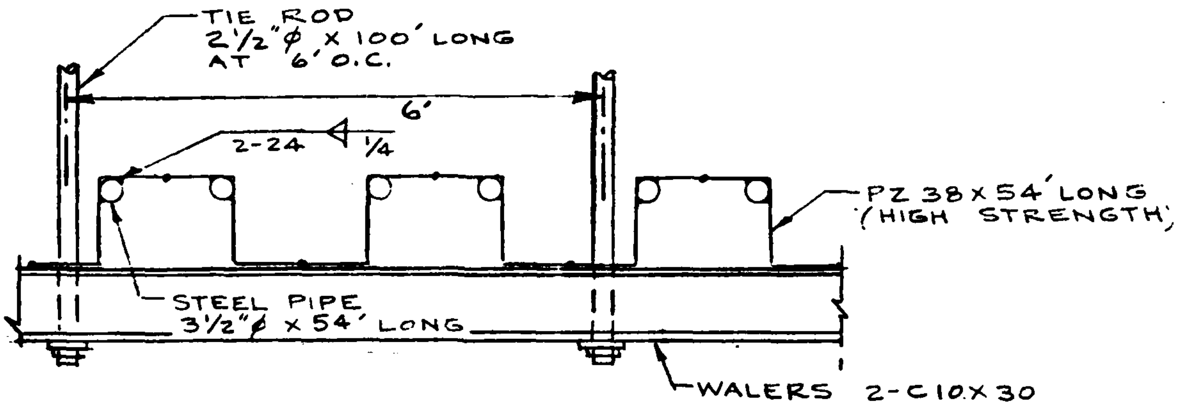

NOTES:
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.
CITY OF BUFFALO
CITY OF LACKAWANNA
BUFFALO RIVER
REPUBLIC STEEL
THRUWAY
NEW YORK STATE
AVENUE
SOUTH PARK
HAMBURG STREET
KATHERINE STREET
MICHIGAN AVENUE
MAIN STREET
GRAIN MILLS
UNION CANAL
HANNA FURNACE
RIDGE ROAD
TIFFT STREET
TIFFT FARM
OHIO STREET
BUFFALO SHIP CANAL
GRAIN MILLS
SAND COMPANY
FUHRMANN BOULEVARD
ERIE BASIN MARINA
BUFFALO RIVER ENTRANCE CHANNEL
BLACK ROCK ENTRANCE CHANNEL
TIMES BEACH
NFTA
ALLEN BOAT COMPANY SLIP
INDEPENDENT CEMENT
BETHLEHEM STEEL
DEEPEN TO 30'
DEEPEN TO 28'
2000'
750'
OUTER HARBOR
TURNING BASIN
LACKAWANNA CANAL
CONSTRUCT 1000' OF NEW BREAKWATER
REMOVE 750' OF EXISTING BREAKWATER
DEEPEN TO 32'
DIKE NUMBER 4
CONSTRUCT 500' OF NEW BREAKWATER
NORTH ENTRANCE
SOUTH ENTRANCE
LAKE ERIE
SCALE OF FEET
2000' 0 2000' 4000'
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
ALTERNATIVE IVb
U.S. ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE C8

BY J.K.K. DATE 1/6/82 SUBJECT BUFFALO HARBOR STUDY SHEET NO. ...... OF ......

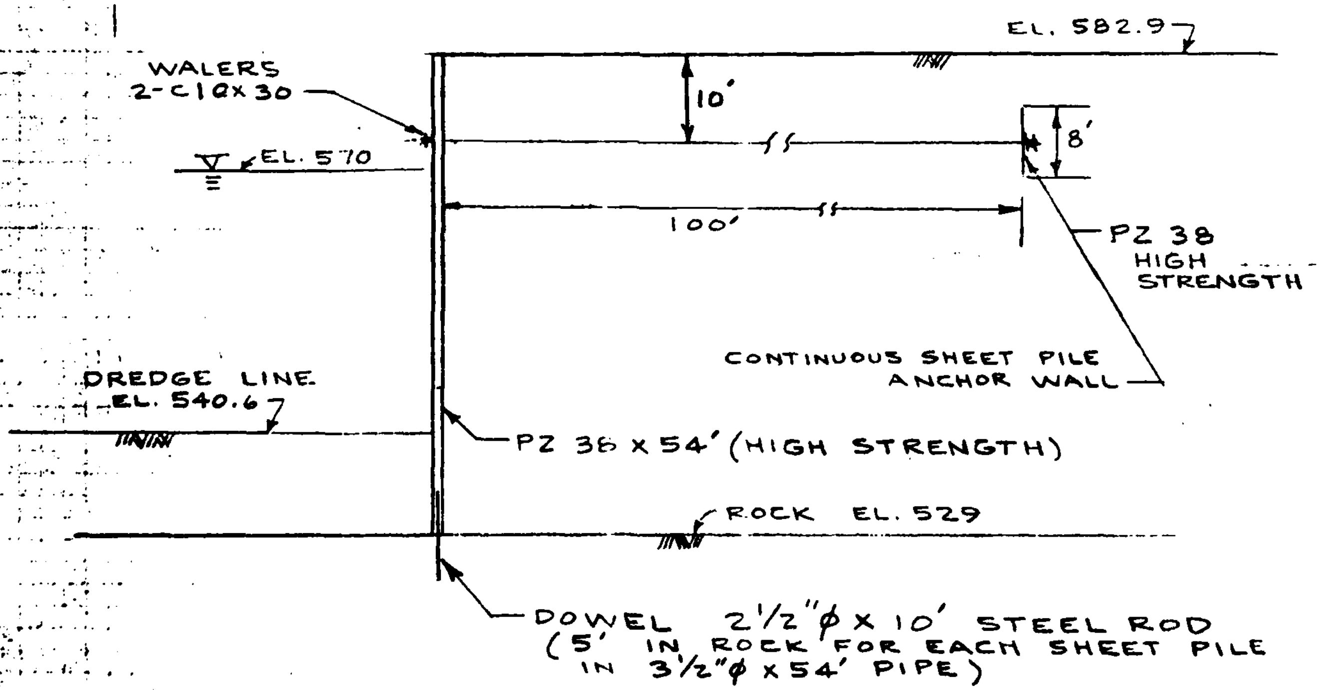
CHKD. BY ...... DATE ...... JOB NO. AAK010211.000000

TYPE I BULKHEAD



PLAN

SCALE: 1/2=1'



SECTION

LWD AT EL. 568.6

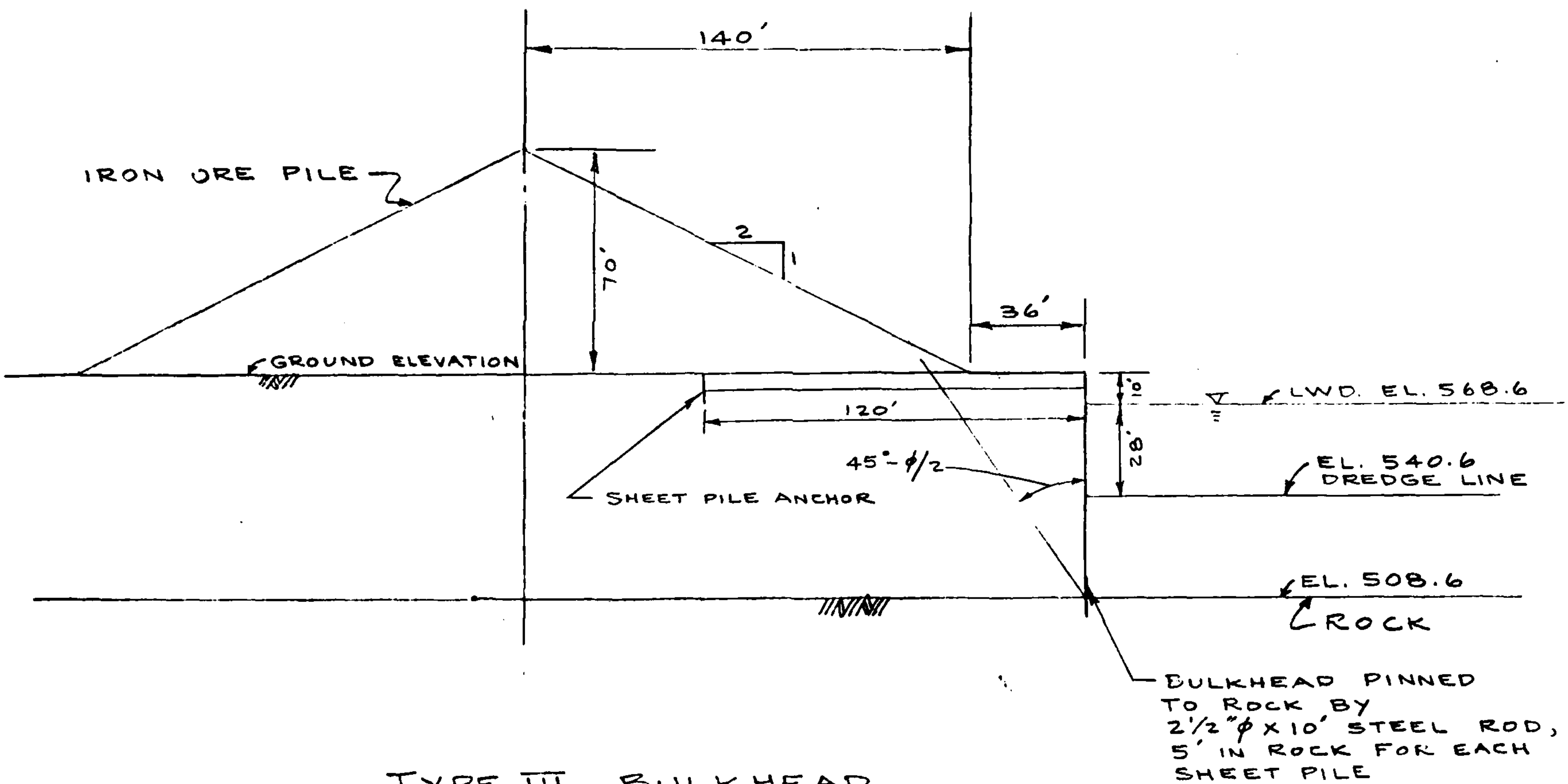
PLATE C-9

ASSUME : CLAY-SILT FILL

$\phi = 20°$

$\gamma = 110\ lb/ft^3$

$C = 250\ lb/ft^2$

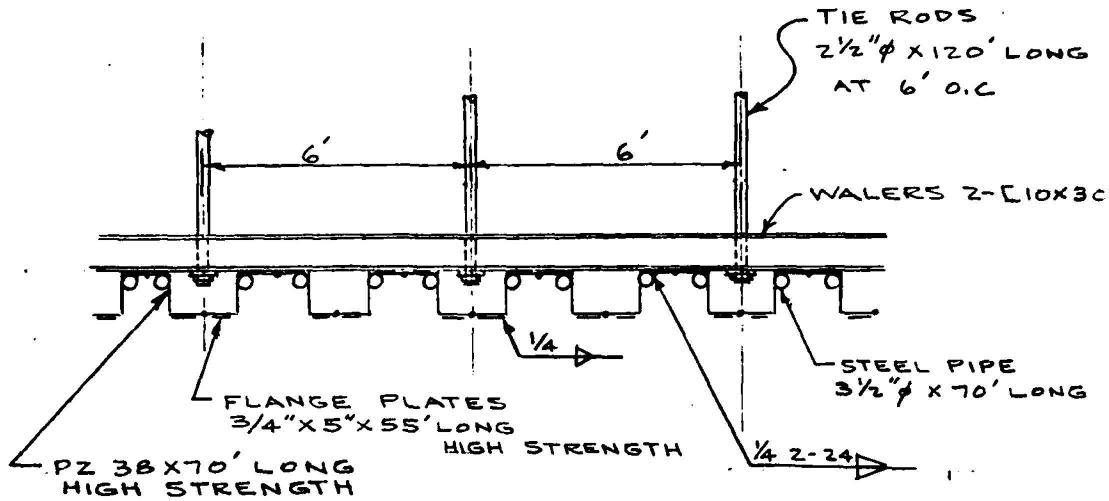


TYPE III BULKHEAD

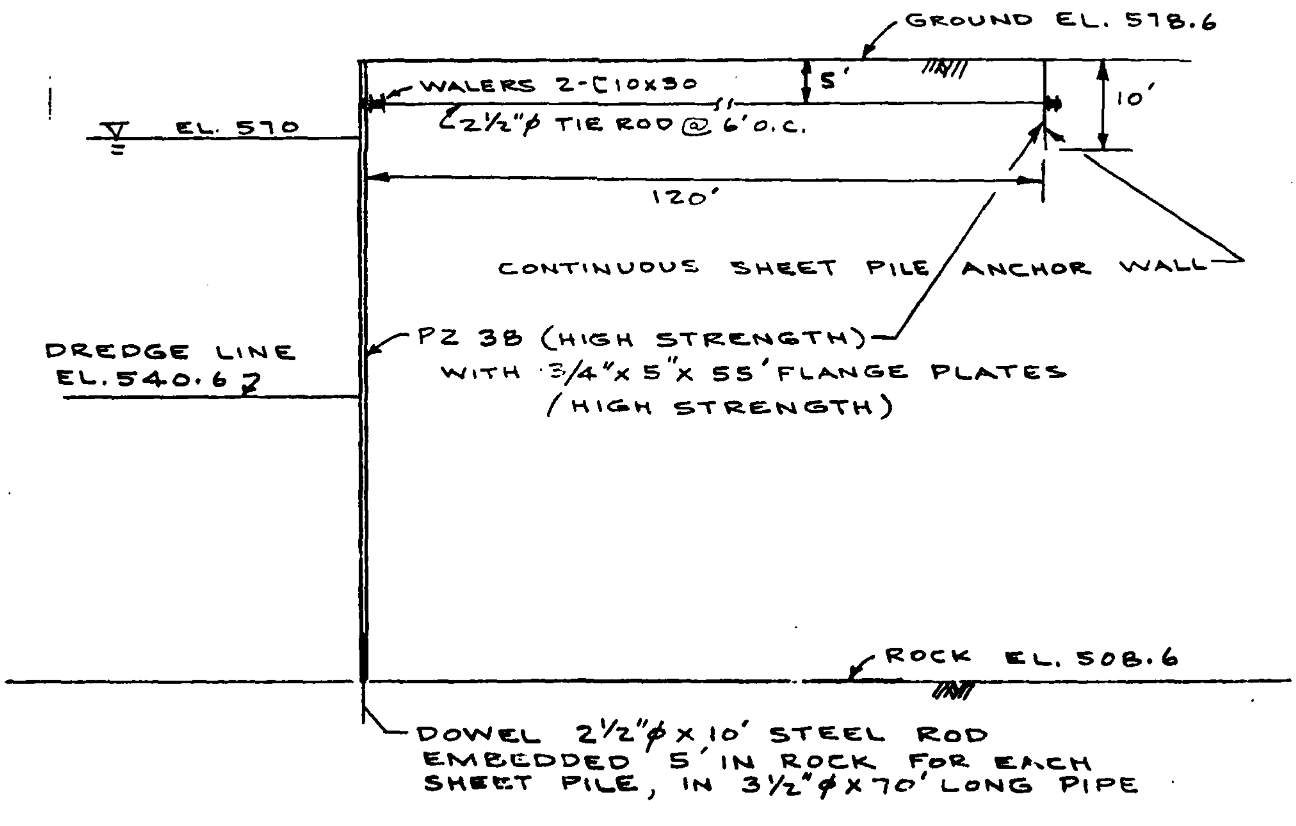
WITH IRON ORE STORAGE

PLATE C-10

TYPE III BULKHEAD



PLAN
SCALE: 1/4" = 1'-0"



SECTION

LWD AT EL. 568.6

PLATE C-11

APPENDIX D
COST ESTIMATES

BUFFALO HARBOR, NY

PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, NY 14207

BUFFALO HARBOR, NY
PRELIMINARY FEASIBILITY REPORT

APPENDIX D
COST ESTIMATES

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D4	Quantity Estimates	D-1
D5	Estimate of First Cost of Construction and Annual Operation and Maintenance Costs	D-2

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D2	Estimate of Cost, Alternative No. 2e	D-7
D3	Estimate of Cost, Alternative No. 3f	D-11
D4	Estimate of Cost, Alternative No. 3g	D-14
D5	Estimate of Cost, Alternative No. 3h	D-17
D6	Estimate of Cost, Alternative No. 3c	D-20
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ATTACHMENT

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APPENDIX D
COST ESTIMATES

D1. PURPOSE

This appendix presents the detailed estimates of cost for the eight preliminary alternatives considered in detail during Stage 2 planning for the Buffalo Harbor study.

D2. COST DATA SOURCES

All cost data presented in this appendix are at June 1982 price levels. Unit prices shown in the various alternatives were developed from similar construction projects and updated by use of the Engineering News Record (ENR) Construction Cost Index.

a. Navigation Aids. The costs for the Navigation Aids were supplied by the Ninth Coast Guard District Office in Cleveland.

b. Railroad Interchange System. The extimated costs for the Railroad Interchange System in Alternative No. III were computed from Mean's R&R Cost Data, 1982.

c. Lands and Damages. Lands and Damage costs were developed by the North Central Division Real Estate Office.

d. Contingencies. A contingency factor has been applied to the first cost of construction to account for variations in material unit prices, quantities, methods of construction, and material storage and disposal.

D3. TOPOGRAPHIC AND SUBSURFACE INFORMATION

Information available at the District Office to prepare the estimates, consisted of 1981 and 1982 Project Condition Soundings for Buffalo Harbor, including the Buffalo River and Ship Canal, a 1978 Lake Survey Chart provided by the National Oceanic and Atmospheric Administration, and 1982 Aerial Topography.

D4. QUANTITY ESTIMATES

a. Dredging. Outer Harbor dredged material quantities are based on 1978 Project Condition Soundings for deepening existing channels, and a 1978 Lake Survey Chart for dredging new channels. Buffalo River and Ship Canal quantities are based on Project Condition Soundings for deepening existing channels, and 1981 Aerial Photography for new bank cuts. An overdepth allowance of 1 foot and 2 feet for rock excavation have been incorporated into the dredging quantity calculations. As discussed in the Main Report, it has been assumed that all dredged material will be placed in Buffalo Diked Disposal Area.

b. Breakwaters. Breakwater stone quantities have been developed from typical sections shown on plates for breakwater design. Size of stone has

been based on design considerations discussed in Appendix A, "Coastal Engineering Design."

c. Existing Bulkhead Removal/Modifications. Quantities and existing conditions used to determine the cost of removing or modifying existing bulkheads along the Buffalo River Ship Canal were developed from Department of Army Permit applications available at the District Office and found in the Cleveland Harbor report.

d. New Bulkheads. Quantities associated with the new bulkheads have been developed from typical sections shown on Plates through .

D5. ESTIMATE OF FIRST COST OF CONSTRUCTION AND ANNUAL OPERATION AND MAINTENANCE COSTS

The estimated first costs of construction and additional annual operation and maintenance costs for the eight alternatives considered in this Stage 2 study, at June 1982 price levels, are presented in Tables through . The operation and maintenance costs are based upon past experience for similar maintenance work performed in the Buffalo District. The annual operation and maintenance costs for the aids to navigation required in Alternative No.s IIe; IIIf, g, h, i; and IV a and b were furnished by the Ninth Coast Guard District Office in Cleveland, OH.

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IId					INVITATION NO.
ITEM NO.	DESCRIPTION Option I	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	25' Project Depth				
	Summary				
	Federal				$45,100,000
	Non Federal Cost				37,812,000
	Total First Cost				$82,912,000
	Estimated Additional Annual Maintenance Costs				
	2) Dredging	54,000	C.Y.	6.60	$356,400

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/13/82
✓ Ripp / 8/13/82

REASONABLE CONTRACT ESTIMATE

SHEET 1 OF 2

PROJECT: Buffalo Harbor Study, Alternative IId

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Option 1				
	25' Project Depth				
	Federal Cost				
	Section 6				
	Dredging	1,075,285	CY	2.50	2,688,213
	Rock Excavation	291,852	CY	34.00	9,922,968
	Total				12,611,181
	Section 7				
	Dredging	453,333	CY	2.50	1,133,333
	Rock Excavation	155,833	CY	34.00	5,298,322
	Total				6,431,655
	Section 8				
	Dredging	145,184	CY	2.50	362,960
	Section 9				
	Dredging	71,971	CY	2.50	179,928
	Rock Excavation	135,019	CY	34.00	4,590,646
	Total				4,770,574
	Section 10				
	Dredging	85,000	CY	6.60	561,000
	Rock Excavation	32,000	CY	34.00	1,088,000
	Total				1,649,000
	Section 11				
	Dredging	127,667	CY	6.60	842,602
	Rock Excavation	30,666	CY	34.00	1,042,644
	Total				1,885,246
	Section 12				
	Dredging	33,738	CY	6.60	222,671
	Rock Excavation	107,499	CY	34.00	3,654,966
	Total				3,877,637
	SubTotal				31,538,253

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

-J. Wheeler 8/13/82
✓ Egg/ 8/25/82

REASONABLE CONTRACT ESTIMATE					SHEET 2 OF 2
PROJECT Buffalo Harbor Study, Alternative IId					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Option 1				
	25' Project Depth				
	Federal Cost				
	Sub Total				31,588,253
	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				31,958,253
	Contingencies @ 20% ±				6,341,747
	Total Contractor's Earnings Plus Contingencies				38,300,000
	Engineering & Design				3,300,000
	Supervision & Administration				3,500,000
	Total Federal First Cost of Construction				45,100,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/13/82
V Repp 8/25/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IId

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Option I				
	25' Project Depth				
	Non Federal Cost				
	Section 10				
	SSP Bulkhead Type I	2900	LF	2,590.35	$7,512,015
	Fenders Protection	160	LF	1,164.25	186,280
	Demolition of Bldgs. [redacted]		L.S.		2,213,145
	Relocation of Utilities		L.S.		58,500
	Total Sect. 10				9,969,940
	Section 11				
	SSP Bulkhead Type I	5060	LF	2,590.35	13,107,171
	Fender Protection	320	LF	1,164.25	372,558
	Demolition of Bldgs.		LS		3,092,354
	Relocation of Utilities		LS		40,500
	Total Sect. 11				16,612,583
	Total Contractors Earnings				26,582,523
	Contingencies @ 20% ±				5,317,477
	Total Contractor's Earnings Plus Contingencies				31,900,000
	Engineering & Design				2,900,000
	Supervision & Administration				2,900,000
	Total Non Federal Cost of Construction				$37,700,000
	Lands & Damages		L.S.		112,000
	Total First Non Federal Cost of Construction				$37,812,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/13/82
✓ Reg(?) 8/25/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IIe					INVITATION NO.
ITEM NO.	DESCRIPTION Option 2	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Federal Cost				$ 43,900,000
	Non Federal Cost				40,012,000
	Total First Cost				$ 83,912,000
	Estimated Additional Annual Maintenance Costs				
	a) Dredging				
	Harbor	7000	C.Y.	2.50	$ 17,500
	River	54000	CY	6.60	356,400
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				$ 389,400

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/17/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IIe					INVITATION NO.
ITEM NO.	DESCRIPTION Option 2	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
	28' Project Depth				
	Section 1				
	Dredging	594,074	CY	2.50	$ 1,485,185
	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	79,000	CY	20.50	1,619,500
	New Breakwater				
	a) Armor Stone 13 ton	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.20	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
	Section 3				
	Dredging	258,000	CY	2.50	645,000
	Section 4				
	Dredging	91,666	CY	2.50	229,165
	Section 5				
	Dredging	976,944	CY	2.50	2,442,360
	25' Project Depth				
	Section 7				
	Dredging	643,791	CY	2.50	1,621,978
	Rock Excavation	38,519	CY	34.00	1,309,646
	Total Section 7				2,931,624
	Section 8				
	Dredging	253,815	CY	2.50	634,538
	Section 9				
	Dredging	35,999	CY	2.50	89,997
	Rock Excavation	135,019	CY	34.00	4,590,646
	Total Section 9				4,680,643
	Section 10				
	Dredging	85,000	CY	6.60	561,000
	Rock Excavation	32,000	CY	34.00	1,088,000
	Total Section 10				1,649,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. J. Wheeler

Sub Total $24,845,068

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IIc

INVITATION NO.

ITEM NO.	DESCRIPTION Option 2	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
	25' Project Depth				
	Sub Total				$24,845,068
	Section 11				
	Dredging	127,667	CY	6.60	842,602
	Rock Excavation	30,666	CY	34.00	1,042,644
	Total				1,885,246
	Section 12				
	Dredging	33,738	CY	6.60	222,671
	Rock Excavation	107,499	CY	34.00	3,654,966
	Total				3,877,637
	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				30,977,951
	Contingencies @ 20% ±				6,222,049
	Total Contractor's Earnings Plus Contingencies				37,200,000
	Engineering & Design				3,300,000
	Supervision & Administration				3,400,000
	Total First Federal Cost of Construction				43,900,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. J. Wheeler 8/24/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IIe

INVITATION NO.

ITEM NO.	DESCRIPTION Option 2	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
	28' Project Depth				
	Lackawanna Canal				
	Dredging	29,629	C.Y.	6.60	195,551
	Rock Excavation	42,962	C.Y.	34.00	1,460,708
	Total				1,656,259
	25' Project Depth				
	Section 10				
	SSP Bulkhead Type I	2900	LF	2590.35	7,512,015
	Fenders Protection	160	LF	1164.25	186,280
	Demolition [redacted] of Bldgs.		LS		2,213,145
	Relocation of Utilities		LS		58,500
	Total Sect. 10				9,969,940
	Section 11				
	SSP Bulkhead Type I	5060	LF	2590.35	13,107,171
	Fender Protection	320	LF	1164.25	372,558
	Demolition		LS.		3,092,354
	Utilities Relocation				40,500
	Total Sect. 11				16,612,583
	Total Contractor's Earnings				28,238,782
	Contingencies @ 20% ±				5,661,218
	Total Contractor's Earnings Plus Contingencies				33,900,000
	Engineering & Design				3,000,000
	Supervision & Administration				3,000,000
	Total Non Federal Cost of Construction				39,900,000
	Lands & Damages		LS.		112,000
	Total First Non Federal Cost of Construction				40,012,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J Wheeler 8/17/82

GPO : 1967 OF—

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IIIf					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Federal Cost				$19,600,000
	Non Federal Cost				19,585,000
	Total Cost				$39,185,000
	Estimated Additional Annual Maintenance Cost				
	a) Dredging Harbor	2000	CY	2.50	$ 5,000
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				$ 20,500

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. J. Wheeler 8/18/82 GPO : 1967 O—265-000

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative III-f					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
	Section 1				
	Dredging	594,074	CY	2.50	1,485,185
	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	79,000	CY	20.50	1,619,500
	New Breakwater				
	a) Armor Stone	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.10	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
	Section 3				
	Dredging	258,000	CY	2.50	645,000
	Section 4				
	Dredging	91,666	CY	2.50	229,165
	Section 5				
	Dredging	295,009	C.Y.	2.50	737,522
	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				13,614,425
	Contingencies @ 20% ±				2,785,575
	Total Contractor's Earnings Plus Contingencies				16,400,000
	Engineering & Design				1,500,000
	Supervision & Administration				1,700,000
	Total First Federal Cost of Construction				19,600,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative III f

INVITATION NO.

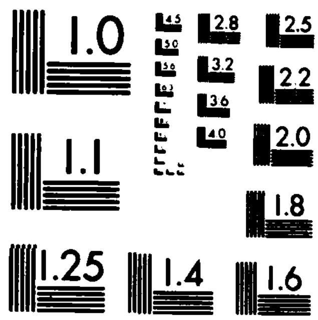
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
	Allen Boat Slip				
	Dredging	259,259	CY	6.60	1,711,109
	Bulkhead Type III	2600	LF	3669.95	9,541,859
	Total				11,252,968
	Lackawanna Canal				
	Dredging	29,629	CY	6.60	195,551
	Rock Excavation	42,962	CY	34.00	1,460,708
	Total				1,656,259
	Loaders Front End	2	EA.	100,000	200,000
	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				13,479,227
	Contingencies @ 20% ±				2,720,773
	Total Contractor's Earnings Plus Contingencies				16,200,000
	Engineering & Design				1,500,000
	Supervision & Administration				1,700,000
	Total Non Federal Cost of Construction				19,400,000
	Lands & Damages		LS		185,000
	Total First Non Federal Cost of Construction				19,585,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/19/82

AD-A129 189 BUFFALO HARBOR STUDY PRELIMINARY FEASIBILITY REPORT VOLUME II APPENDICES(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT APR 83 4/8

UNCLASSIFIED F/G 13/2 NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study. Alternative IIIg					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Federal Cost				$19,600,000
	Non Federal Cost				19,997,000
	Total Cost				$39,597,000
	Estimated Additional Annual Maintenance Costs				
	a) Dredging	2000	CY	2.50	$ 5000
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				$ 20,500

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IIIg

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
	Section 1				
	Dredging	594,074	CY	2.50	1,485,185
	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	79,000	CY	20.50	1,619,500
	New Breakwater				
	a) Armor Stone	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.10	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
	Section 3				
	Dredging	258,000	CY	2.50	645,000
	Section 4				
	Dredging	91,666	CY	2.50	229,165
	Section 5				
	Dredging	295,009	C.Y.	2.50	737,522
	Mob. & Demob.		L.S.		370,000
	Total Contractor's Earnings				13,614,425
	Contingencies @ 20% ±				2,785,575
	Total Contractor's Earnings Plus Contingencies				16,400,000
	Engineering & Design				1,500,000
	Supervision & Administration				1,700,000
	Total First Federal Cost of Construction				19,6 00,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative III9					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
	Allen Boat Slip				
	Dredging	259,259	CY	6.60	1,711,109
	Bulkhead Type III	2600	LF	3669.95	9,541,859
	Total				11,252,968
	Lackawanna Canal				
	Dredging	29,629	CY	6.60	195,551
	Rock Excavation	42,962	CY	34.00	1,460,708
	Total				1,656,259
	Railways				
	New Track	2000	LF	102.26	204,520
	Upgrade Track	7100	LF	13.20	93,720
	Switches & Turnouts		LF		82,514
	Total				380,754
	Loaders, Front End	2	EA.	100,000	200,000
	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				13,859,981
	Contingencies @ 20% ±				2,740,019
	Total Contractor's Earnings Plus Contingencies				16,600,000
	Engineering & Design				1,500,000
	Supervision & Administration				1,700,000
	Total Non Federal Cost of Construction				19,800,000
	Lands & Damages				197,000
	Total First Non Federal Cost of Construction				$19,997,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IIIh

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
1	Federal Cost				$ 18,200,000
2	Non Federal Cost				21,970,000
	Total Cost for Alternative				$ 40,170,000
	Estimated Additional Annual Maintenance Costs				
	a) Dredging	2000	CY	2.50	$ 5000
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				$ 20,500

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IIIh

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
1	Section 1				
	Dredging	594,074	CY	2.50	$ 1,485,185
2	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	77,030	CY	20.00	1,619,500
	New Breakwater				
	a) Armor Stone	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.10	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
3	Section 3				
	Dredging	258,000	CY	2.50	645,000
4	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				12,647,738
	Contingencies @ 20% ±				2,552,262
	Total Contractor's Earnings Plus Contingencies				15,200,000
	Engineering & Design				1,400,000
	Supervision & Administration				1,600,000
	Total First Federal Cost of Construction				$ 18,200,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 6/12/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative III h					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
1	Lackawanna Canal, Dredging	29,629	CY	6.60	195,551
	Rock Excavation	42,962	CY	34.00	1,460,708
	Total				1,656,259
2	Railways				
	1) New Track	8400	LF	102.26	858,984
	2) Upgrade Track	9800	LF	13.20	129,360
	3) Switches	2	EA.	27,457.00	54,914
	Total for Railwork				1,043,258
3	Bulkheads Type III	2800'	LF		
	a) Excavation	156,800	CY	3.50	548,800
	b) Backfill	156,800	CY	1.35	211,680
	c) SSP PZ38	224,000	SF	17.00	3,808,000
	d) Pipe Anchors	1,190,364	lbs	1.40	1,666,510
	e) Dowels	311,556	lbs	1.45	451,756
	f) Flange Plates	2,628,276	lbs	1.15	3,022,517
	g) Wales	224,000	lbs	2.25	504,000
	h) Tie Rods	1,006,208	lbs	1.40	1,408,691
	Total				11,621,954
4	Site Development	153,000	C.Y.	2.96	452,880
5	Front End Loaders	2	Ea.	100,000	200,000
6	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				15,344,351
	Contingencies @ 20% ±				3,055,649
	Total Contractor's Earnings Plus Contingencies				18,400,000
	Engineering & Design				1,600,000
	Supervision & Administration				1,900,000
	Total Non Federal Cost of Construction				$21,900,000
	Lands & Damages		LS.		70,000
	Total First Non Federal Cost of Construction				$21,970,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative III;					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Federal Cost				$18,200,000
	Non Federal Cost				20,326,000
					$38,526,000
	Estimated Additional Annual Maintenance Costs				
	a) Dredging	2000	CY	2.50	$ 5000
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				$ 20,500

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE: J. Wheeler 8/19/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative III

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
1	Section 1				
	Dredging	594,074	CY	2.50	$ 1,485,185
2	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	79,000	CY	20.50	1,619,500
	New Breakwater				
	a) Armor Stone	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.10	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
3	Section 3				
	Dredging	258,000	CY	2.50	645,000
4	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				12,647,738
	Contingencies @ 20% ±				2,552,262
	Total Contractor's Earnings Plus Contingencies				15,200,000
	Engineering & Design				1,400,000
	Supervision & Administration				1,600,000
	Total First Federal Cost of Construction				$ 18,200,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative III					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
1	Lackawanna Canal, Dredging	29,629	CY	6.60	195,551
	Rock Excavation	42,962	CY	34.00	1,460,708
	Total				1,656,259
2	Bulkheads Type III	2800'	LF		
	a) Excavation	156,800	CY	3.50	548,800
	b) Backfill	156,800	CY	1.35	211,680
	c) SSP PZ38	224,000	SF	17.00	3,808,000
	d) Pipe Anchors	1,190,364	lbs	1.40	1,666,510
	e) Dowels	311,556	lbs	1.45	451,756
	f) Flange Plates	2,628,276	lbs	1.15	3,022,517
	g) Wales	224,000	lbs	2.25	504,000
	h) Tie Rods	1,006,208	lbs	1.40	1,408,691
	Total				11,621,954
3	Site Development	153,000	C.Y.	2.96	452,880
4	Front End Loaders	2	Ea.	100,000	200,000
5	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				14,301,093
	Contingencies @ 20% ±				2,898,907
	Total Contractor's Earnings Plus Contingencies				17,200,000
	Engineering & Design				1,500,000
	Supervision & Administration				1,600,000
	Total Non Federal Cost of Construction				$20,300,000
	Lands & Damages			LS.	26,000
	Total First Non Federal Cost of Construction				$20,326,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IVa

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Federal Cost				$21,800,000
	Non Federal Cost				3,100,000
	Total First Cost				$24,900,000
	Estimated Additional Annual Maintenance Costs				
	a) Dredging	2000	CY	2.50	$ 5,000
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				20,500

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IVa					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
	Section 1				
	Dredging	594,074	CY	2.50	1,485,185
	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	79,000	CY	20.50	1,619,500
	New Breakwater				
	a) Armor Stone	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.10	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
	Section 3				
	Dredging	258,000	CY	2.50	645,000
	Section 4				
	Dredging	91,666	CY	2.50	229,165
	Section 5				
	Dredging	976,944	C.Y.	2.50	2,442,360
	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				15,319,260
	Contingencies @ 20% ±				3,080,740
	Total Contractor's Earnings Plus Contingencies				18,400,000
	Engineering & Design				1,700,000
	Supervision & Administration				1,700,000
	Total First Federal Cost of Construction				21,800,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IVa					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
1.	Lackawanna Canal				
	Dredging	29,629	CY	6.60	195,551
	Rock Excavation	42,962	CY	34.00	1,460,708
	Total				1,656,259
2	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				2,026,259
	Contingencies @ 25% ±				473,741
	Total Contractor's Earnings Plus Contingencies				2,500,000
	Engineering & Design				300,000
	Supervision & Administration				300,000
	Total Non Federal Cost of Construction				3,100,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. J. Wheeler 8/20/82 GPO : 1967 OF—[illegible]

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IIb

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Federal Cost				$18,200,000
	Non Federal Cost				3,100,000
	Total				$21,300,000
	Estimated Additional Annual Maintenance Costs				
	a) Dredging	2000	CY	2.50	$ 5,000
	b) Breakwater		LS		15,000
	c) Navigation Aids		LS		500
	Total				$ 20,500

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/18/82

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Alternative IVB					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
1	Section 1				
	Dredging	594,074	CY	2.50	$ 1,485,185
2	Section 2				
	Dredging	333,865	CY	2.50	834,663
	Demolition S. Breakwater	79,000	CY	20.50	1,619,500
	New Breakwater				
	a) Armor Stone	121,200	Ton	31.20	3,781,440
	b) Underlayer Stone	37,500	Ton	34.10	1,278,750
	c) Bedding Stone	113,500	Ton	23.20	2,633,200
	Total				7,693,390
	Total Section 2				10,147,553
3	Section 3				
	Dredging	258,000	CY	2.50	645,000
4	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				12,647,738
	Contingencies @ 20% ±				2,552,262
	Total Contractor's Earnings Plus Contingencies				15,200,000
	Engineering & Design				1,400,000
	Supervision & Administration				1,600,000
	Total First Federal Cost of Construction				$ 18,200,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/12/82

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Alternative IVb

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
1.	Lackawanna Canal				
	Dredging	29629	CY	6.60	195,551
	Rock Excavation	42,962	CY	34.00	1,460,708
	Total				1,656,259
2	Mob. & Demob.		LS		370,000
	Total Contractor's Earnings				2,026,259
	Contingencies @ 25% ±				473,741
	Total Contractor's Earnings Plus Contingencies				2,500,000
	Engineering & Design				300,000
	Supervision & Administration				300,000
	Total Non Federal Cost of Construction				3,100,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

J. Wheeler 8/20/82

REAL ESTATE ESTIMATE

OF

BUFFALO HARBOR STUDY - STAGE II

COMMERCIAL NAVIGATION

(Alternative II d, e, III f - i, IV a, b,)

BUFFALO, NEW YORK

1. Description of Project Area:

Eight project alternatives are being considered in addition to those considered and valued in the Real Estate Estimate made as of 17 November 1981. The harbor improvements and transshipment routes identified are within the area of the Buffalo Harbor, Buffalo River and the Buffalo Ship Canal. The harbor is south of the Central Business District in an area zoned for industrial usage with manufacturing, grain storage and recreational boat storage as the principal land uses.

2. Valuation Problems:

Two of the alternatives are water locations and are considered to be under navigational servitude. The other alternatives are on portions of land which are zoned for manufacturing and will require both permanent and temporary easements of varying widths for the transshipment routes. In addition temporary work easements will be required for route and bulkhead construction areas and for removal of specified buildings. The total acreage requirement for each alternative is identified below. The expansion of a boat slip will require valuation of a parcel in fee.

3. Valuation Analysis:

Based on an inspection of the subject sites and similar parcels of land in the Buffalo area, and giving consideration to location, topography, size, utilities, water frontage, access and zoning, it is estimated that the fee value for the alternative sites are as listed below on a per acre basis and the totals rounded.

The value of permanent easements has been estimated at 50 per cent of the fee value estimates due to the limitation of the easement.

The value of the temporary work easements has been estimated at 10 per cent of the fee value for the various sites on the typical rate of return on investment in the area. The annual charge for temporary use of the land is computed on this basis. A 20 per cent contingency factor was considered in all estimates.

The area that the alternate transshipment routes will be located in is mainly zoned for industrial usage and is partially improved with railroad yards, grain storage, storage yards and access streets, the routes appear to take advantage of existing rights-of-ways under expressways and main overpasses.

Alternate IId:

LAND

Temporary Easement - Bulkhead Replacement:	
Fee value = 13.1 acres X $8,500 per acre = $111,350.	
Temporary easement = $111,350 X 10% = $11,135, say	$11,000
Temporary Easements - Buildings Removal:	
Fee value = 15.6 acres X $10,000 = $156,000.	
Temporary easement = $156,000 X .10 = $15,600, say	$16,000
Total easements	$27,000

IMPROVEMENTS: (Excluding Remolition Costs)

Connecting Terminal Building	$20,000	
Ganson Street Building	8,000	
Agway Buildings	38,000	
Total Improvements		$66,000
Total Land, and improvements		$93,000
Damages		-0-
Total Land, Improvements and Damages		$93,000
Contingencies at 20%		+18,600
Total Land, Improvements, Damages and Contingencies		$111,600
Rounded to		$112,000

Alternative IIe:

Same requirements as Alternative IId for a total of: $112,000

Alternative IIf:

LAND

Land in fee: 1.84 acres (Boat slip)	
1.84 acres X $12,000 per acre = $22,080, say	$22,000
Permanent Easement: 3.44 acres (Transfer site)	
Fee Value: 3.44 acres X $12,000 per acre = $41,280.	
$41,280 X .50 = $20,640, say	$21,000
Temporary Easement: 8.95 acres (Bulkheads)	
Fee Value: 8.95 acres X $12,000 per acre = $107,400.	
$107,400 X .10 = $10,740, say	$11,000
Total land costs	$54,000
Damages	-0-
Contingencies, at 20%	$10,800
Total land, damages and contingencies	$64,800
Rounded to	$65,000

IMPROVEMENTS:

A 10,000 square foot steel framed metal storage building on slab foundation.

Estimated value:

10,000 square feet X$10 p.s.f. = $100,000		
Contingencies at 20%	20,000	
Total Improvements and contingencies		$120,000
Total land buildings, damages and contingencies		$185,000

Alternative IIIg:

LAND

Land in fee: 1.84 acres (Boat slip)		
1.84 acres X $12,000 = $22,080, say		$22,000
Permanent Easement: Transfer site - 3.44 acres		
Fee Value: 3.44 acres X $12,000 per acre = $41,280.		
$41,280 X .50 = $20,640 say	$21,000	
Rail R.O.W. - 2.3 acres		
Fee value: 2.3 acres X $8,700 per acre = $20,010		
$20,010 X .50 = $10,005, say	$10,000	
Total permanent easement		$31,000
Temporary Easement: 8.95 acres (Bulkheads)		
Fee Value: 8.95 acres X $12,000 per acre = $107,400.		
$107,400 X .10 = $10,740, say		$11,000
Total land cost		$64,000
Damages		-0-
Contingencies at 20%		$12,800
Total land, damages and contingencies		$76,800
Rounded to		$77,000

IMPROVEMENTS:

A 10,000 square foot steel frame metal storage building on slab foundation.

Estimated Depreciated value:

10,000 square feet X $10.00 p.s.f. = $100,000		
Contingencies at 20%	20,000	
Total Improvement and contingencies		$120,000
Total land buildings, damages and contingencies		$197,000

Alternative IIIh:

Permanent Easement:

Transfer Point - 3.44 acres
Fee value = 3.44 acres X $12,000 per acre = $41,280.
$41,280 X .50 = $20,640, say $21,000

Rail R.O.W. - 9.64 acres	
Fee value = 9.64 acres X $7,500 per acre = $72,300.	
$72,300 X .50 = $36,150, say	$36,000
Total permanent easements	$57,000
Temporary Easements: .69 acre (Bulkheads & Site Prep)	
Fee value = .69 acres X $12,000 per acre = $8,280.	
$8,280 X .10 = $828, say	$1,000
Total land costs	$58,000
Damages	-0-
Contingencies at 20%	$11,600
Total land buildings, damages and contingencies.	$69,600
Rounded to	$70,000

Alternative IIIi:

Permanent Easement - 3.44 acres	
Fee value = 3.44 acres X $12,000 per acre = $41,280.	
$41,280 X .50 = $20,640, say	$21,000
Temporary Easement - .69 acre	
Fee value = .69 acre X $12,000 per acre = $8,280.	
$8,280 X .10 = $828, say	$1,000
Total land costs	$22,000
Damages	-0-
Contingencies at 20%	$4,400
Total land, damages, and contingencies.	$26,400
Rounded to	$26,000

Alternative IVa - Navigational servitude.

Alternative IVb - Navigational servitude.

CERTIFICATION:

I hereby certify that I have carefully examined the properties described and that the estimates as developed in this report represent my unbiased judgment of the present Fair Market estimate of the property subject only to assumptions and limiting conditions as specifically set forth herein.

Based on the information contained in this report, but not limited thereto the estimated Acquisition Cost of the Project as of 10 August 1982, is in the amounts of:

Alternative IId	\$112,000
Alternative IIe	\$112,000
Alternative IIIf	\$185,000
Alternative IIIg	\$197,000
Alternative IIIh	\$70,000
Alternative IIIi	\$26,000
Alternative IVa	-0-
Alternative IVb	-0-

R. M. Stefanski
ROBERT M. STEFANSKI
Appraiser
Real Estate Division

STATEMENT OF LIMITING CONDITIONS AND ASSUMPTIONS:

In making the value estimate of the subject project, the following assumptions and limiting conditions are presented:

1. That merchantable fee simple titles, free of encumbrances, are vested in the ownerships of record.

2. That all data obtained from the township assessor records and local realtors used in compiling this report are considered reliable, but the appraiser does not guarantee their correctness.

3. That the estimated value is merely a rough estimate and does not constitute a formal appraisal report.

4. That exhibits attached to this report are solely for the purpose of assisting the reader to visualize and understand its contents and are not intended to be exact in scale or detail.

5. That no attempt has been made to render an opinion relative to title or status of easements or any other matter of a legal nature.

6. That I have no present or contemplated future interest in the property.

7. The cost of relocation of public utilities is not included in this appraisal.

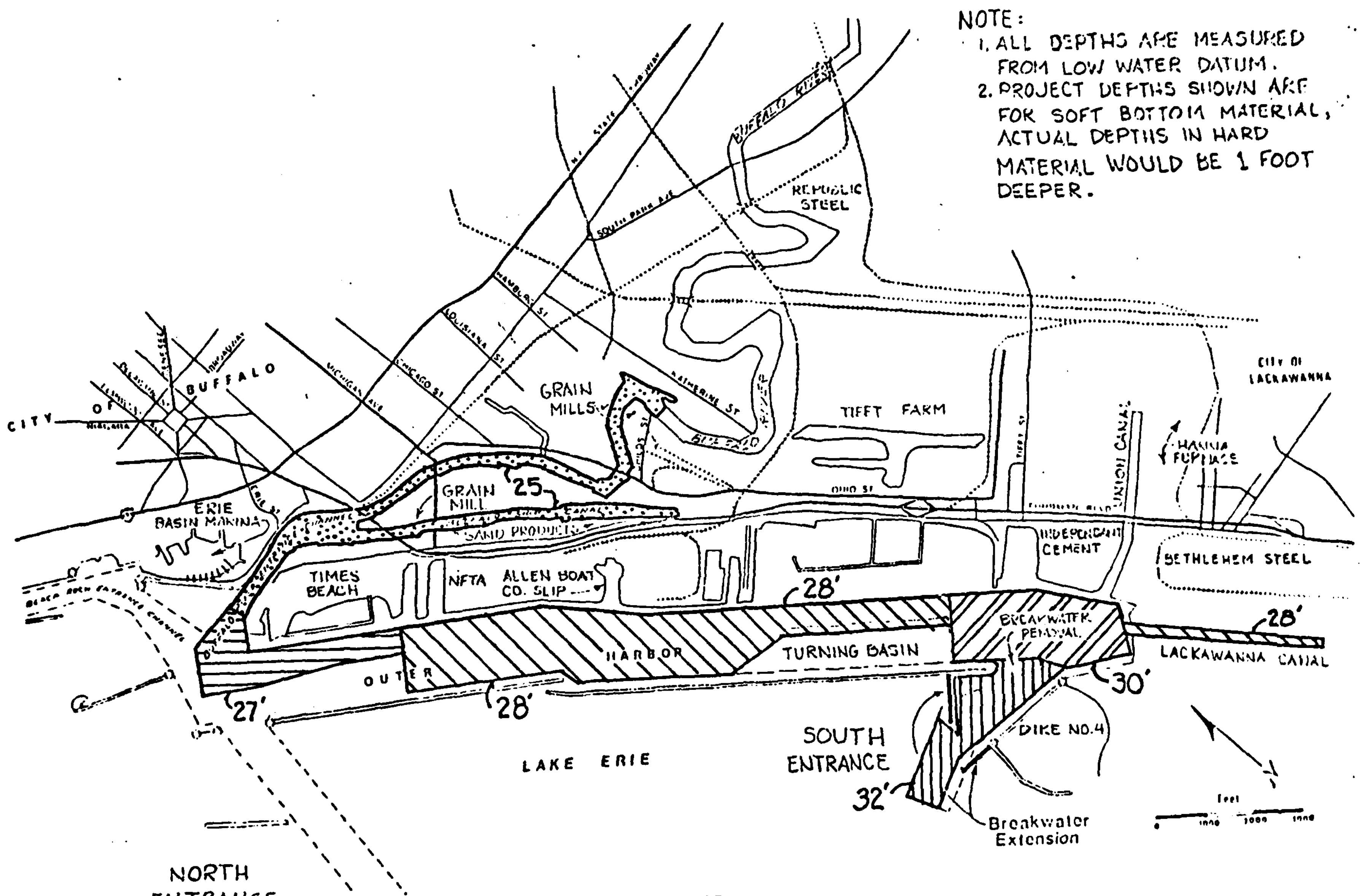
8. The City is assumed to own sufficient interest in street right-of-way to permit construction of the conveyer system within the street limits.

9. The cost of temporarily bridging the railroad tracks and the River is considered construction costs and is not included in this appraisal.

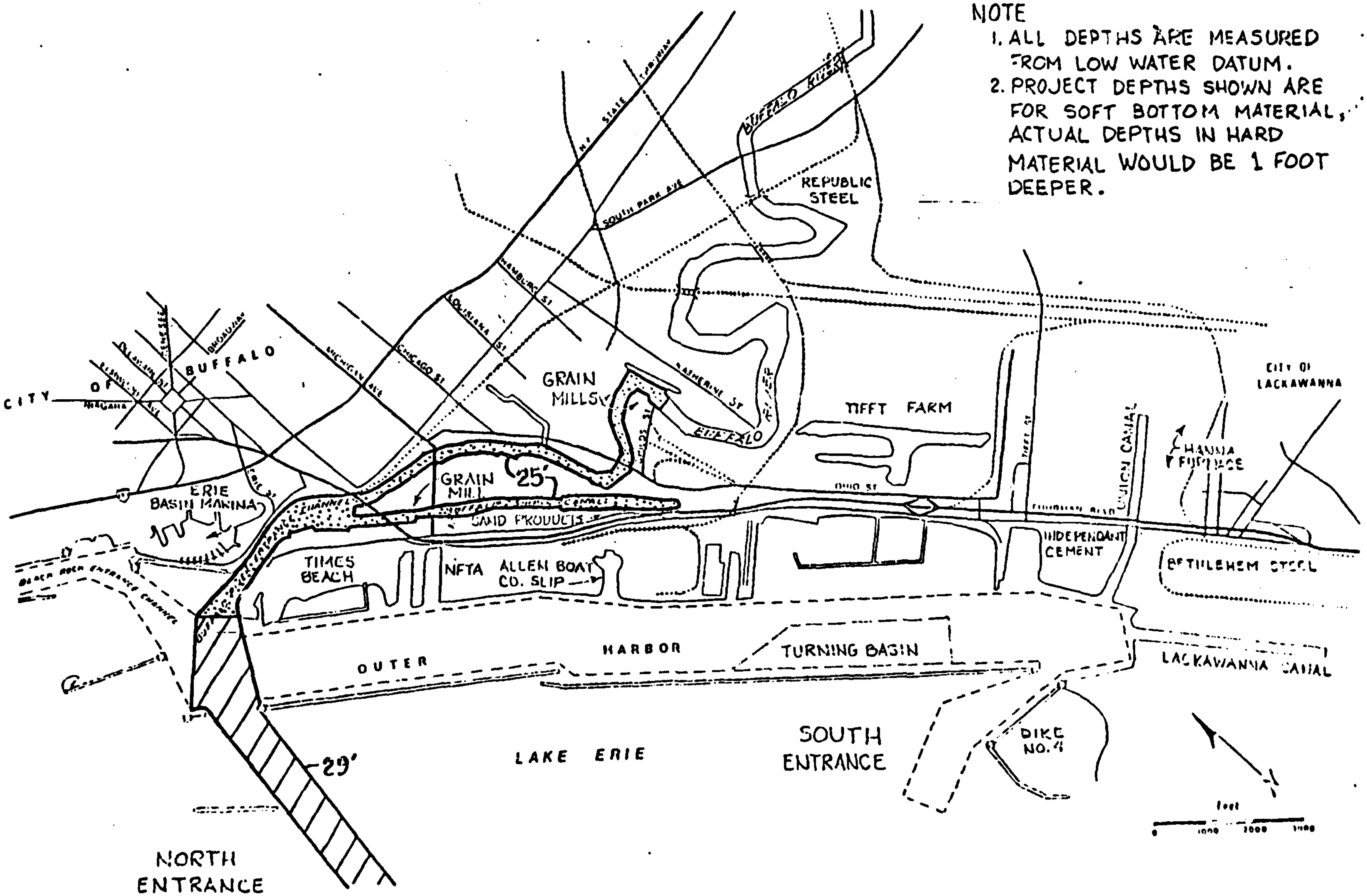
10. It is assumed that no property will lose its access as a result of this taking.

11. This appraisal bases right-of-way needs for the elevated portion to have a minimum of 27' clearance over roads and railroads.

12. It is assumed that right-of-way locations for distribution conveyers will be designed for the conveyer structure to miss existing improvements.

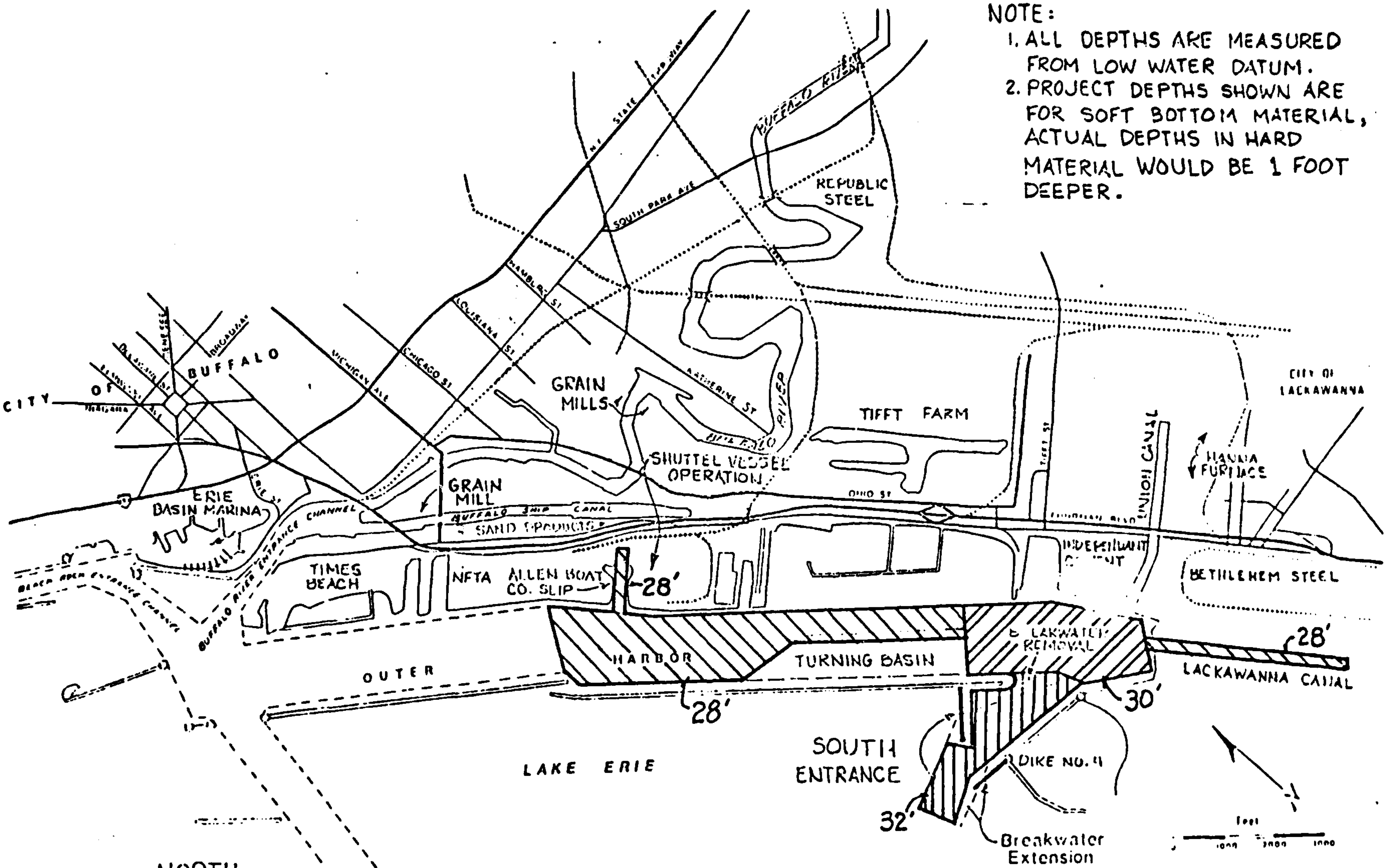


ALTERNATIVE IIc

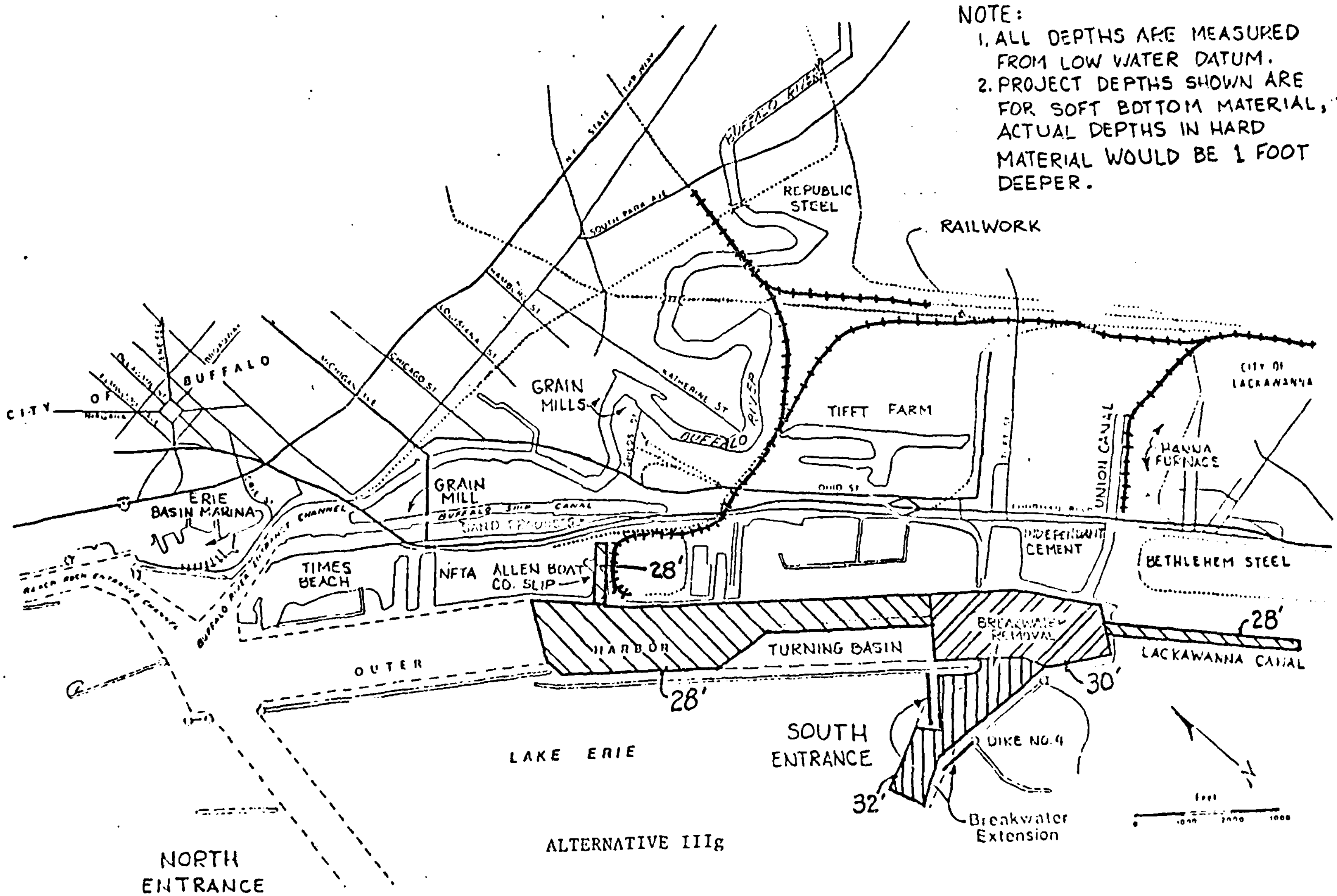


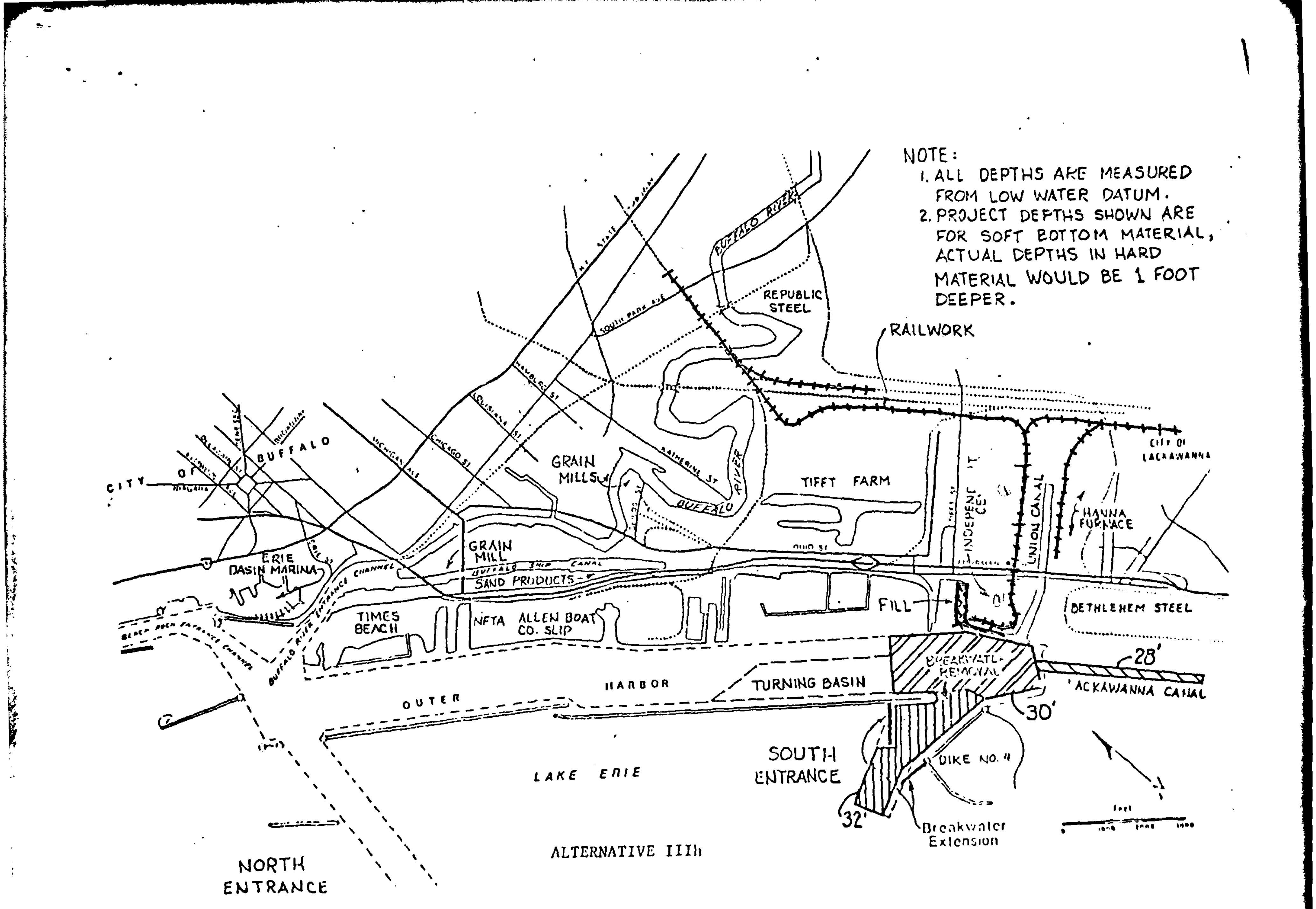
ALTERNATIVE IId

NOTE:
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.

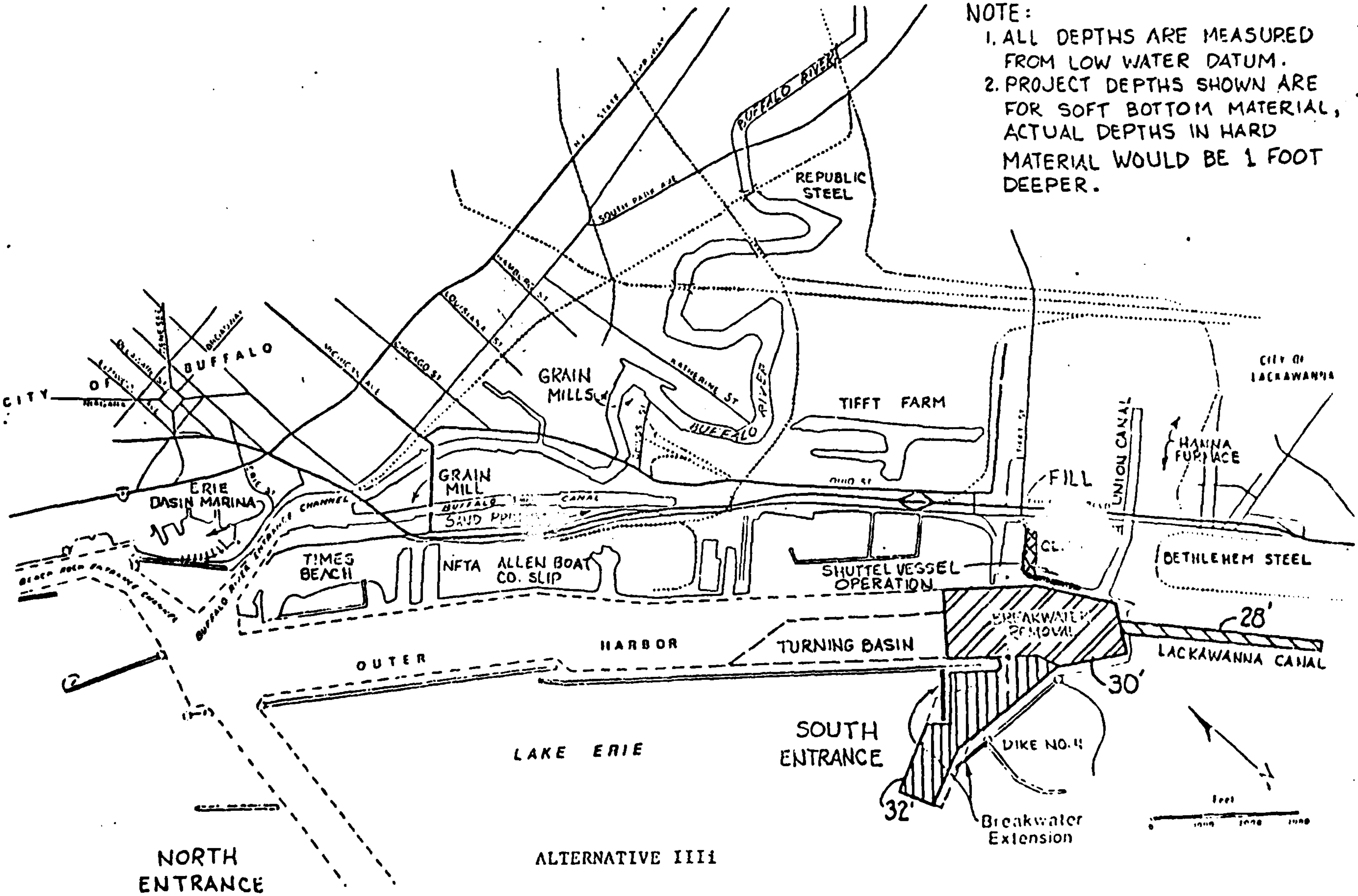


ALTERNATIVE IIIf


NOTE:
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.
RAILWORK
REPUBLIC STEEL
BUFFALO RIVER
CITY OF BUFFALO
GRAIN MILLS
GRAIN MILL
TIFFT FARM
CITY OF LACKAWANNA
HANNA FURNACE
UNION CANAL
INDEPENDENT CEMENT
BETHLEHEM STEEL
ERIE BASIN MARINA
TIMES BEACH
NFTA
ALLEN BOAT CO. SLIP
28'
HARBOR
TURNING BASIN
BREAKWATER REMOVAL
28'
LACKAWANNA CANAL
30'
OUTER
28'
SOUTH ENTRANCE
DIKE NO. 4
32'
Breakwater Extension
LAKE ERIE
NORTH ENTRANCE
ALTERNATIVE IIIg

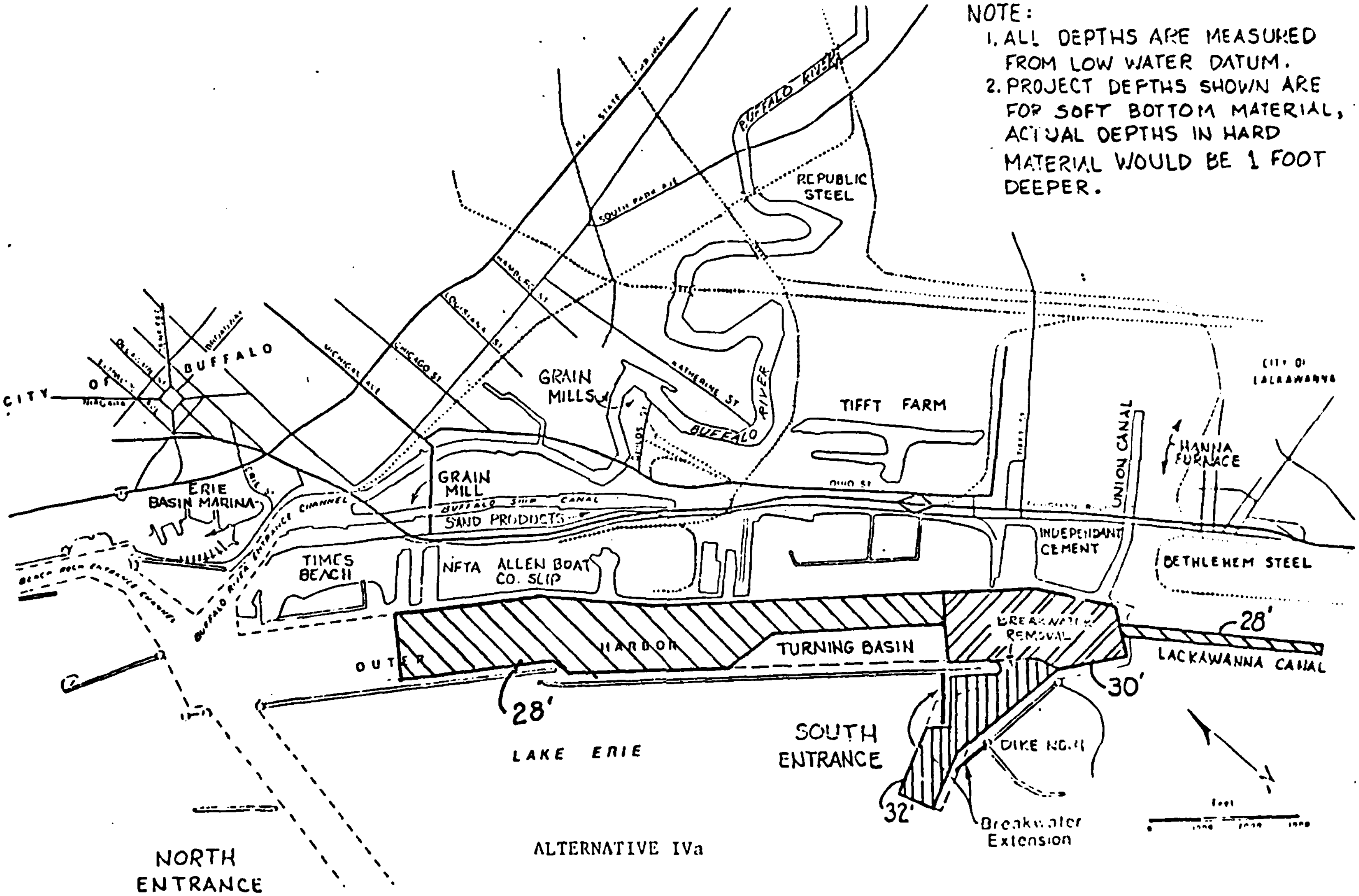


ALTERNATIVE IIIh

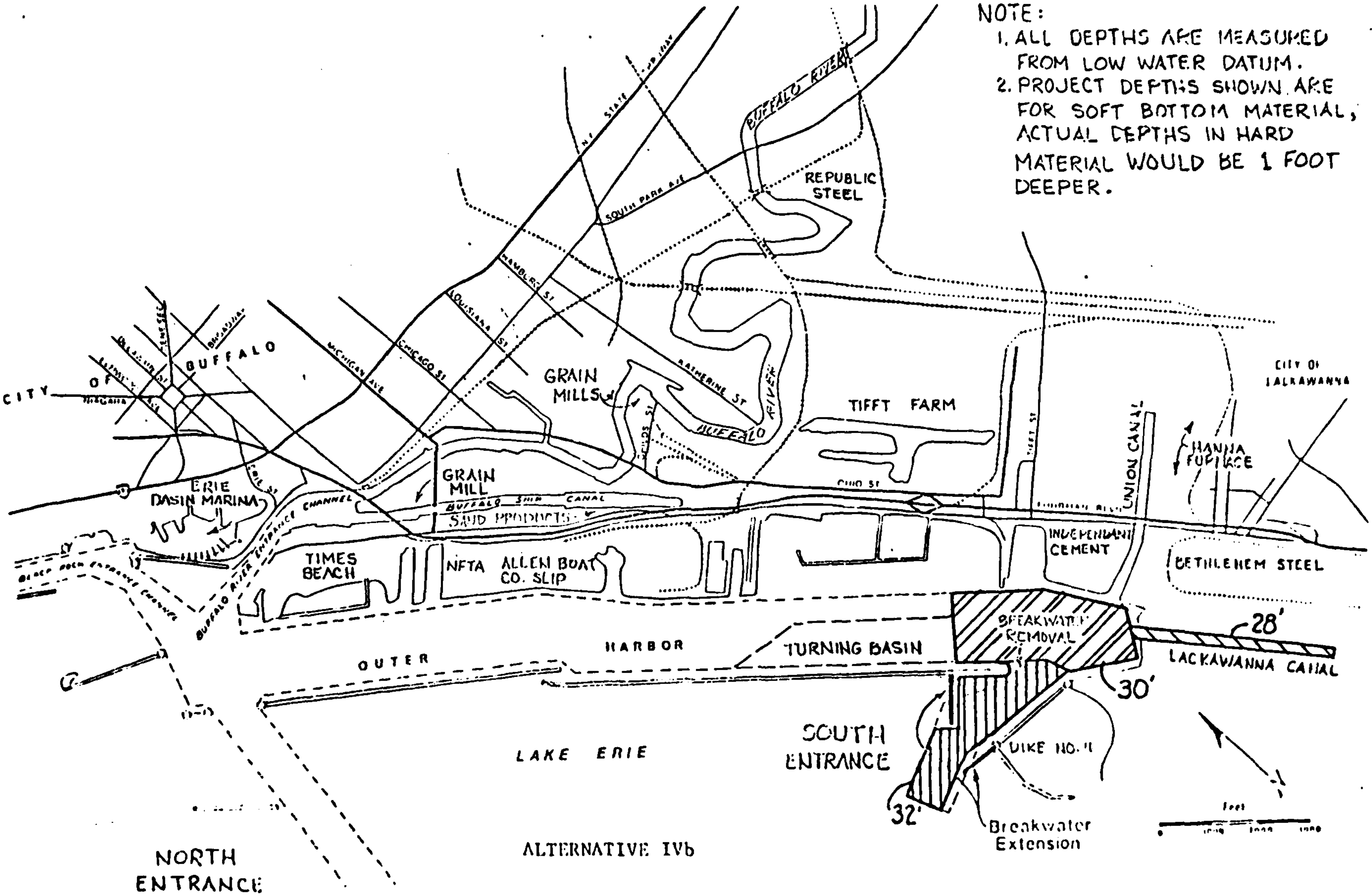


ALTERNATIVE IIIi

NOTE:
1. ALL DEPTHS ARE MEASURED FROM LOW WATER DATUM.
2. PROJECT DEPTHS SHOWN ARE FOR SOFT BOTTOM MATERIAL, ACTUAL DEPTHS IN HARD MATERIAL WOULD BE 1 FOOT DEEPER.



ALTERNATIVE IVa



ALTERNATIVE IVb

APPENDIX E
GEOTECHNICAL

BUFFALO HARBOR, NY

STAGE II
PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

BUFFALO HARBOR PRELIMINARY FEASIBILITY REPORT
STAGE 2
APPENDIX E

GEOTECHNICAL

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BUFFALO HARBOR PRELIMINARY FEASIBILITY REPORT

GEOTECHNICAL

APPENDIX E

E1. REGIONAL GEOTECHNICAL INFORMATION

a. Physiography.

Buffalo Harbor is located in Erie County at the eastern end of Lake Erie at the head of the Niagara River. It consists of a lakefront, a breakwater-protected Outer Harbor and an Inner Harbor which includes the Buffalo River Entrance Channel, a section of the Buffalo River and the Buffalo Ship Canal.

The study area is situated in the Erie-Ontario Lowland. This physiographic province has been subdivided into three main regions, the Tonawanda Plain, the Erie Plain and the Allegany Plateau. The boundary between the Tonawanda and Erie Plain is delineated by the Onondaga Escarpment and between the Erie Plain and Allegany Plateau by the Portage Escarpment.

The altitude and relief of the land increases from 565 feet in the northern portion of Erie County to 1,945 feet above sea level in the southeastern portion.

A prominant feature in this area is the Onondaga Escarpment. It has a north facing cliff formed by a resistant caprock of Onondaga Limestone running from the Niagara River eastward through Akron.

During late Pleistocene time, glacial Lake Tonawanda covered the area between the Onondaga Escarpment and ran parallel to the Niagara Escarpment.

The Erie Lake Plain was also covered by glacial lakes during Pleistocene time. As a result, the topography is generally level to gently rolling.

The third region, the Allegany Plateau, lies in the southern third of the county. This hilly topography appears to be primarily a result of stream erosion as there are no significant folds or faults. Glaciation has rounded the shape of the hills and produced U-shaped valleys.

b. Bedrock Geology.

The bedrock of the study area is sedimentary rock primarily of the Ordovician, Silurian, and Devonian Periods. These rocks are sandstones, shales, limestones, dolostones, and conglomorates. Outcrops occur along the Lake Erie shoreline, along stream channels, and at the Niagara, Onondaga and Portage escarpments.

c. Structural Geology.

The rock of Western New York produces a homocline which dips southward to southwestward at approximately 40 feet per mile. Modifications of the dip

are produced by small terraces and low folds. Small anticlines occur in the Devonian shale and siltstone beds. These folds are probably a result of gravity creep rather than tectonics.

Well developed joints occur as two diagonal sets in the gray and black shales. Smooth joint surfaces are produced by spalling of the shale.

d. Surficial Geology.

The surficial geology of the study area is mainly a result of the Pleistocene glaciation which deposited these sediments within the past million years. The moraines and till sheets of Erie County were deposited during the Port Huron Substage (12,000 years ago). The lake escarpment moraine system covers most of the face of the Lake Erie Escarpment. This escarpment separates the hills of the Allegany Plateau from the lake plain. Other major moraines of the region are the Gowanda, Hamburg and Niagara Falls. These moraines consist of unsorted, unstratified deposits of sand, silt and clay.

Lacustrine sediments occur in the Erie and Tonawanda Plain. Some ancient beach ridges also occur in the lake plains.

e. Seismicity.

According to the seismic zone map of the contiguous states, Figure E1, the area of interest is in a Seismic Zone 2. Should seismic activity occur, the damages would be of moderate extent.

f. Ground Water.

The ground water in the study region occurs both in bedrock and in unconsolidated deposits and is withdrawn in large quantities by industries and municipalities. The main ground water controls are climate and geology and replenishment of water to the rocks is directly from water and snowfall. The amount of replenishment to the aquifers is dependent upon the absorptive capacity of the soil and underlying rock, topography, vegetal cover, wind temperature, humidity and the form, intensity and amount of precipitation.

The aquifers differ in the quantity and quality of the water in storage and their ability to yield water according to the character of the rock. These differences are related directly to the character of the rock. The rock formations in the study region are among the largest yielding rock aquifers in New York State. The Salina formation consisting of crystalline dolomite and dolomite shale is the best aquifer in the area.

g. Sedimentation.

The port area of Buffalo Harbor has been improved by dredging and other means of harbor maintenance and protection. A 22-foot depth is maintained by the Corps of Engineers. The primary source of sediment is contributed by the Buffalo River and its tributaries, industrial waste and storm sewers.

E2. LOCAL GEOTECHNICAL INFORMATION

a. Subsurface Explorations.

There were no subsurface explorations performed during this phase of the study. A survey was conducted throughout 1981 to collect available subsurface exploration information in the study area. Information was obtained from various local sources, both public and private sector, and from previous studies by the Buffalo District Corps of Engineers. The Plan of Subsurface Explorations is shown on Plate E1.

(1) Corps of Engineers Programs - A total of 60 borings from studies and projects by the Buffalo District Corps of Engineers on Buffalo Harbor were used to develop profiles and sections for this report. These studies and projects included Michigan Avenue Bridge Abutments Repair, 1979. Confined Dredging Disposal Area, 1974; Maintenance Dredging 1971, Dike Disposal Area No. 2; Maintenance Dredging 1967, Disposal Area; Deepening Soundings 1964; North Entrance Improvements, 1959; Widening Buffalo River at Ohio Street Bridge, 1958; South Pier, Buffalo River Entrance, 1957; Deepening South Outer Harbor and Removal of Shoals, 1952; Buffalo River and Ship Canal, 1940; Proposed Rock Shoal Removal, 1940; Proposed Breakwater Extensions.

(2) Programs by Others - A total of 65 borings obtained from the public and private sector were used to develop profiles and sections for this report. They included: New York State Department of Transportation, Fuhrman Boulevard, Hamburg Turnpike, High Level Bridge; Conrail - U.G. Bridge 392.47 running track 101, U.G. Bridge 393.23 running track 101, U.G. Bridge 1.76 Buffalo Creek, U.G. Bridge 1.71 mainline Buffalo to Chicago; Buffalo Sewer Authority - contract documents for the construction of Kelly Island Sanitary Sewer Project, Sections 1 and 2, EPA Project No. C-36-1070; Bethlehem Steel Corporation - Union and Lackawanna Canals.

b. Test Data.

(1) Corps of Engineers Programs - Field and laboratory testing was performed as outlined below:

(a) Field Testing. Penetration tests were performed during most of the subsurface explorations conducted by the Corps of Engineers. The boring logs and other available information have not been included here.

(b) Laboratory Testing. Several sets of laboratory tests were run on samples obtained from the newest subsurface exploration programs. A summary of the test results has not been included here.

(2) Programs by Others - Field and laboratory testing was performed as outlined below:

(a) Field Testing. Penetration tests were performed during most of the subsurface explorations obtained from the public and private sector. The boring logs and other available information have not been included here.

(b) Laboratory Testing. Limited laboratory testing was performed and has not been included here.

c. Surficial Geology.

Geologic profiles and cross sections have been prepared using available boring information to show subsurface conditions, but have not been included here.

Geologic profiles and sections in the Outer Harbor area show that the sediment is recent dark gray silty clay overlying stiffer red to brown clay. Depth to bedrock varies from approximately -20 feet LWD to -70 feet LWD.

Surficial sediment at the entrance channels is sand to gravel. Below this, in the South Entrance, is a unit of clay overlying a sandy gravel unit. Depth to bedrock varies from about -60 feet LWD to -82 feet LWD.

In the North Entrance Channel below the surficial sediment are thin layers of sand and clay. Depth to bedrock occurs at about -30 feet LWD.

In general, the surficial sediment of the Buffalo River is fill with clay, sand and gravel occurring below. Depth to bedrock along the Buffalo River in the project area varies from -20 LWD to -55 LWD.

The surficial sediment of the Buffalo Ship Canal is fill with alternating layers of clay, silt and sand. The depth to bedrock ranges from -13 LWD to -42 LWD.

In general, the Lackawanna Canal is fine grained sediment overlying sand, gravel and boulders. The surficial sediment of the Union Canal is fill with clay, silt sand, and gravel lying below.

d. Bedrock Geology.

The Buffalo Harbor Project is located in the Onondaga Limestone Formation of Middle Devonian time. This formation was deposited about 350 million years ago in shallow seas. It consists of the Moorehouse, Nedrow, and Edgecliff Members. The Moorehouse is a light gray limestone containing numerous corals and dark gray chert nodules. The Nedrow is intermixed light gray limestone and dark gray chert. The Edgecliff is a light gray limestone with some light gray chert nodules locally represented by a coral bioherm.

e. Structural Geology.

The structure of the study area is a gently dipping homocline which dips southward to southwestward at approximately 40 feet per mile.

Joints occurs in all the units and are best developed in the gray and black shales. They occur as two diagonal sets.

f. Seismicity.

Buffalo Harbor is located in a Seismic Zone 2. This has been defined as an area that would experience moderate damage should seismic activity occur. The seismic zone map of the contiguous states is displayed on Figure E1.

g. Ground Water.

The ground water of the Buffalo area from rock aquifers is among the largest yielding in New York State. Wells drilled in the Lockport dolomite, Salina formation and Onondaga limestone yield large quantities from secondary openings.

The high yielding Salina and Lockport formations are due to the infiltration of water from the Niagara River.

No known extensive gravel deposits overlie the bedrock in this region. The unconsolidated material overlying the bedrock in this area consists of primarily fine sand and clay and is a poor source of water.

h. Sedimentation.

The primary source of sediment which enters Buffalo Harbor is contributed by the Buffalo River and its main tributaries; Cazenovia Creek, Buffalo Creek, and Cayuga Creek.

Buffalo River is a navigable stream extending 6 miles upstream to the confluence of Cazenovia and Buffalo Creeks. It is maintained at a depth of 22 feet by the Corps of Engineers. At its mouth it drains 446 square miles in Erie and Wyoming Counties. Upstream of the project site, the river flows over a bedrock channel.

Cazenovia Creek flows northwesterly from Sardinia to its confluence with Buffalo Creek. The drainage area of 144 square miles in entirely in Erie County.

Cayuga Creek flows westerly from Wyoming County to join Cazenovia Creek. It drains an area of 128 square miles, most of which lies in Erie County.

Buffalo River has very few exposed banks in the project site. Due to the industrial nature of the area, many types of structures have been constructed for bank protection. Dredging of the channel indicates that this is a depositional environment with a minimum amount of erosion.

E3. GEOTECHNICAL DESIGN

a. General.

Several alternatives are under consideration for improving the Buffalo Harbor. These alternatives are presented in greater detail in Appendix D. Presumptive soil parameters were developed, based on the material descriptions, penetration test results, and the very limited laboratory test

results. A preliminary construction material survey was conducted in July 1982 to determine potential sources of stone materials.

b. Project Elements.

Eight different alternatives are under consideration and they fall into three categories: River Improvements for 639-Foot Vessels, Transshipment Options for 1,000-Foot Vessels, or Improvements to the South Entrance for 1,000-Foot Vessels. All eight alternatives include a 1,500-foot extension of the breakwaters at the South Entrance of the harbor except Alternative IId, which involves improvements to the North Entrance only.

(1) River Improvements for the 639-Foot Vessels -

(a) Alternative IId considers the deepening of the North Entrance from 25 feet to a depth of 32 feet; deepening the Outer Harbor from 23 feet to 28 feet, and deepening the Buffalo River and Buffalo Ship Canal from 22 feet to 25 feet.

(b) Alternative IIe considers the deepening of the South Entrance from 29 feet to 32 feet; deepening the Outer Harbor to 28 feet, and deepening the Buffalo River and Buffalo Ship Canal from 22 to 25 feet.

(2) Transshipment Option for 1,000-Foot Vessels -

(a) Alternative IIIf would deepen the South Entrance to 32 feet; deepen the Outer Harbor from approximately Sta. H101+00± to the southerly edge including the Lackawanna Canal, to a depth of 28 feet, and construct new bulkheads at the Allen Boat Company Slip, to facilitate use of a smaller shuttle vessel.

(b) Alternative IIIg is similar to Alternative 3f, except that instead of using a shuttle vessel, a railroad would be used to transfer cargo. Approximately 2,000 feet of track will be placed through the NFTA facilities, which will connect to existing tracks.

(c) Alternative IIIh considers deepening the South Entrance to 32 feet, deepen the Outer Harbor from the area of the NFTA Small-Boat Harbor to the southerly edge including the Lackawanna Canal, to a depth of 28 feet, and place 8,400 feet of railroad track, to connect with existing tracks. New bulkheads would also be constructed in this area.

(d) Alternative IIIi would deepen the South Entrance to 32 feet; deepen part of the Outer Harbor and the Lackawanna Canal to a depth of 28 feet, and make use of a shuttle vessel near the area of the Union Canal.

(3) Improvements to the South Entrance Channel for 1,000-Foot Vessels -

(a) Alternative IVa considers deepening the South Entrance to 32 feet, and deepening the Outer Harbor from approximately Sta. H50+00± to the southerly edge, including the Lackawanna Canal, to a depth of 28 feet.

(b) Alternative IVb would deepen the South Entrance to 32 feet and deepen part of the Outer Harbor and the Lackawanna Canal to a depth of 28 feet.

c. Soil Parameters.

To facilitate the preliminary design of the sheet piles, used for constructing bulkheads, preliminary soil parameters have been developed based on the boring log descriptions, blow counts, and extremely limited laboratory test results. The design parameters as shown in Table E1.

Table E1 - Preliminary Geotechnical Parameters for Sheet Pile Design

Location	Depth (IGLD)	General Classification	Friction Angle	Unit Weight (PCF)	Cohesiveness (PSF)
Sta. C810+00± and Sta. R520+00±	+10 to -18	Fill	30°	100	0
	-18 to -30	Sand	32°	100	0
Sta. R625+00± to Sta. R750+00±	+10 to +5	Fill	30°	100	0
	+5 to -5	Clay	5°	120	1,000
	-5 to -17	Sand & Gravel	34°	115	0
	-17 to -55	Clay (Very Soft)	0°	95	250

Sheet pile will be driven to various depths, and into various materials, depending on the alternative chosen. At shallow depths, it may be necessary to key the sheet piling into the rock, to improve the stability. At the deeper depths, clearing of the driving line may be necessary to insure that standard driving procedures can be followed.

d. Breakwaters and Foundations.

Preliminary analysis indicates that no major settlement will occur and that the typical section developed for the breakwater extension at the South Entrance will not require any revisions. The typical section is displayed on Figure E2.

The deepening alternatives to the Buffalo River, or the Outer Harbor, will encounter primarily silts, sands, clays and fill composed of sand and cinders. There may be limited areas that rock will be encountered, depending on the chosen alternative.

e. Sedimentation Analysis.

An analysis of the sediment deposition into Buffalo Harbor was conducted by the Corps of Engineers (1981), to evaluate the justification for maintaining existing channel dimensions. Several factors contribute to these

long-term variations, many of which are independent of the total quantity of sediment actually deposited within a given year. These factors include lake level fluctuations, the accuracy of measuring the quantity of dredged sediment, reduction in the industrial component, availability of funds for dredging of a given year and others.

The greatest deposition occurs in areas where the river cross sectional area increases. This results in areas where the river widens (as at the confluence of the Buffalo Ship Canal) and where it has been deepened as a result of maintainence dredging. The decrease in flow velocity at these areas produces a natural settling basin for the sediments.

All these factors in combination complicate the analysis of the effect of deepening on annual maintenance dredging.

However, an apparent relationship exists for Buffalo Harbor between water level and dredged volume. Based upon this assumption, an analysis was conducted to determine the effect each project alternative would have on quantities of dredged material. The method used was developed by Berger and Associates for the National Waterways Study. This report states that "there is no known or commonly accepted method of estimating channel dredging requirements other than by extrapolating historical trends and detailed design level studies based hydrographic survey." The method actually used only provides a rough indication of the level of maintenance dredging with increasing project depth.

A relationship between dredged volumes and project depth is presumed.

$$\frac{D1}{D2}^{m} = \frac{V1}{V2}$$

where D1 = present project depth
D2 = alternative project depth
V1 - present shoaling volume
V2 = shoaling volume at alternative project depth
m = a variable dependent upon flow characteristics

Dredging in Buffalo Harbor is complex because the outer harbor is actually dredged in six separate sections at varying depths. The river is dredged in five sections to a constant 22-foot depth. Percentages of annual dredged material for each section are summarized in Table E2.

In calculating projected volumes of dredged material for each alternative, the individual areas were treated separately. The total volumes of the outer harbor and channel are summarized in Table E3.

Table E2 - Approximate Percentage of Annual Dredged Material by Area

Area	Harbor	Station	Percentage
1	South Entrance Channel	S250+00 - S200+00	5
2	South Entrance Channel	S200+00 - S705+00	5
3	Turning Basin		
4	Outer Harbor	H150+00 - H101+00	10
5	Outer Harbor	H101+00 - Ho+00	10
6	North Entrance Channel		0
		Total	35
Area	**River**	**Station**	**Percentage**
11	Buffalo River Entrance Channel		10
12	Buffalo River	R500+00 - R550+00	5
13	Buffalo River	R550+00 - R700+00	10
14	Buffalo River	R700+00 - R750+00	35
15	Buffalo Ship Canal		5
		Total	65

Table E3 - Increases in Dredged Material for Each Alternative

Alternative	Increase (Harbor) (cu yds)	Percent Increase	Increase (Channel) (cu yds)	Percent Increase	Total (cu yds)
IId	0	0	54,000	42	54,000
IIe	7,000	10	54,000	42	61,000
IIIf	2,000	4	0	0	2,000
IIIg	2,000	4	0	0	2,000
IIIh	2,000	3	0	0	2,000
IIIi	2,000	3	0	0	2,000
IVa	2,000	4	0	0	2,000

NOTE: Values rounded to nearest thousand.

(1) General - Several alternatives are under consideration for Buffalo Harbor. They have been described in greater detail in Section E3; however, the effects of each is described below.

(2) Alternative IId - Alternative IId involves no net increase in the outer harbor and 42 percent increase in the channel. This is a net increase of 53,549 cubic yards as a result of a 3-foot deepening.

(3) Alternative IIe - This alternative involves a 10 percent increase of 6,689 cubic yards in the outer harbor and a 42 percent increase in the channel amounting to 53,549 cubic yards of sediment. The channel will be increased from 22 feet to 25 feet and the harbor will be deepened from 25 to 29 feet.

(4) Alternatives IIIf, IIIg, and IVa - These three alternatives involve deepening only portions of the harbor. The effect is 4 percent increase totaling 2,436 cubic yards of material.

(5) Alternatives IIIh and IIIi - The two alternatives IIIh and IIIi involve a deepening of portions of the harbor. A 3 percent increase results producing an additional 2,024 cubic yards of material.

f. Construction Materials Survey.

(1) General - A materials survey was performed in July 1982 to determine possible sources of materials for the alternatives to the Buffalo Harbor Study. An analysis of the quarry investigations, laboratory test results, available service records and the interest of the quarry in producing the required material were the factors used in the survey.

(2) Stone Types - Seven of the eight proposed alternatives require structural modification to the existing harbor. These alternatives have been described in Section E3. The types of stone material required for all of the alternatives are:

Stone Type	Size
Armor Stone	13-29 tons
Underlayer Stone	1-3 tons
Bedding and Core Stone	4-300 pounds
Railraod Ballast NYSDOT No 3a	1 inch - 1-1/2 inches

(3) Specific Gravity of Stone Materials - A specific gravity of 2.48 (155 pcf) was used to compute the stone sizes for the three stone types. A variation in specific gravity equal to $\pm$ 5 percent (2.36 to 2.60) is acceptable. It will be necessary to redesign stone sizes for any source used having a stone material whose specific gravity is not 2.48 $\pm$ 5 percent.

g. Material Quality.

(1) General - Quality requirements for each material type are discussed below. The bedding stone, armore stone, underlayer, and blanket and core have been subjected to the tests established by the Ohio River Division Laboratories, Cincinnati, OH. Test No. P-9, "Riprap and Breakwater Stone Evaluation," includes a suite of tests to determine stone durability.

(2) Armor, Bedding and Core, Underlayer Stone, and Ballast - The stone to be used for this purpose will be free from significant cracks, seams, and overburden spoil. The sources which are suitable for this must not show significant breakdown in the freeze-thaw or wet-dry tests.

h. Material Sources.

(1) General - Armor, bedding and core, underlayer stone, and ballast can be produced from the indicated sources listed on Plates E2 and E3. It is possible that all the material from these sources is not suitable. The right will be reserved in the specifications to reject materials from certain localized areas, zones, strata, channels, or stockpiles when such materials are deemed unsuitable.

Selective quarrying will be required for the production of armor, bedding and core underlayer, and ballast. The specification will require that shale and other undesirable materials will be excluded by adequate processing.

(2) Sources - Seven convenient sources are capable of producing the required material. They are all located within a 30-mile radius of the project and will be transported by barge or truck. Material source information for each material type relating number of possible sources and distances from the project site follows:

Armor Stone - three sources within a 30-mile radius

Underlayer Stone - four sources within a 30-mile radius

Bedding Stone - four sources within a 30-mile radius.

Ballast - seven sources within a 30-mile radius.

E4. REFERENCES

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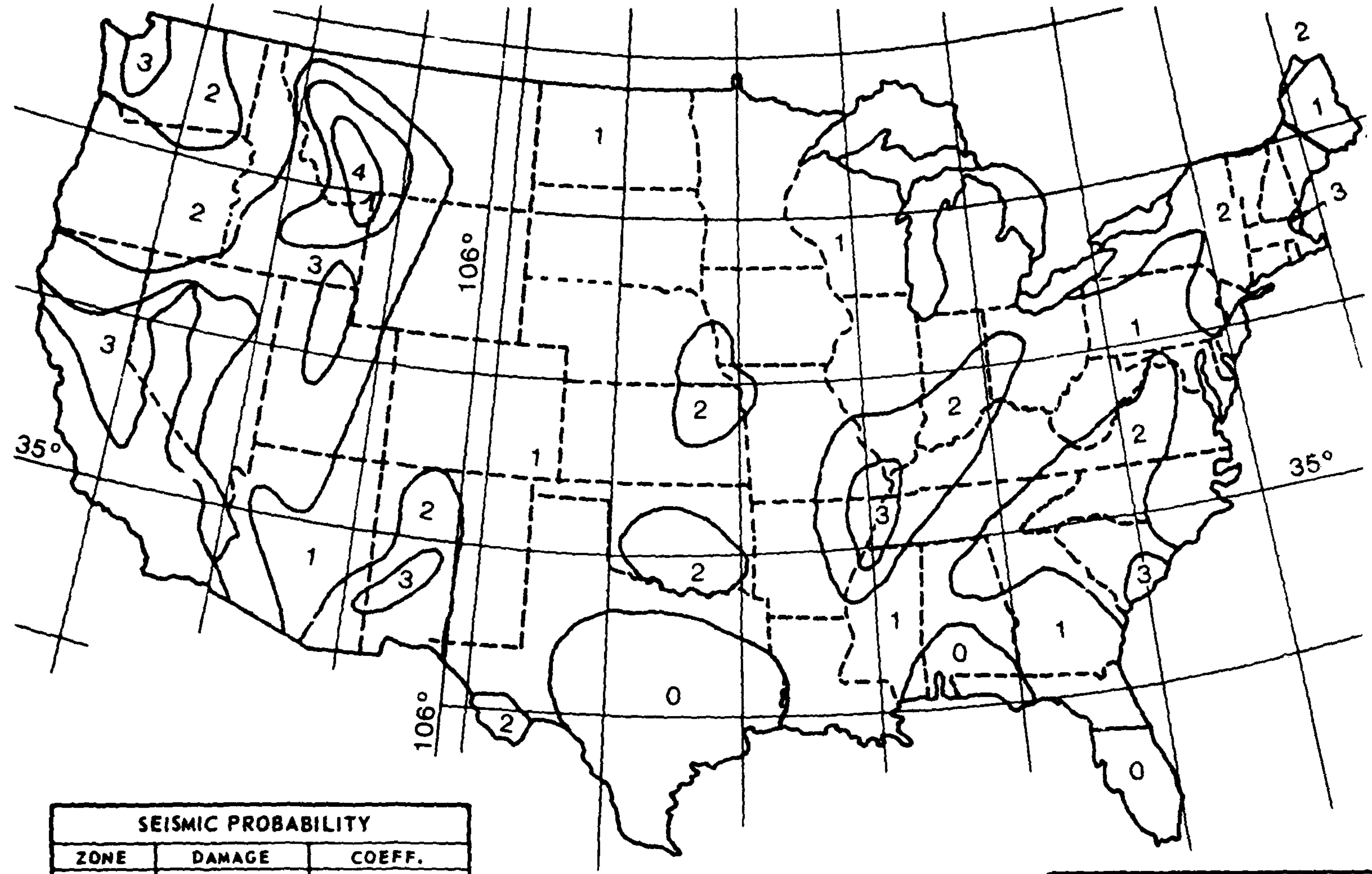


SEISMIC PROBABILITY		
ZONE	DAMAGE	COEFF.
0	NONE	0
1	MINOR	0.025
2	MODERATE	0.05
3	MAJOR	0.10
4	GREAT	0.15

SEISMIC ZONE MAP
OF THE
CONTIGUOUS STATES

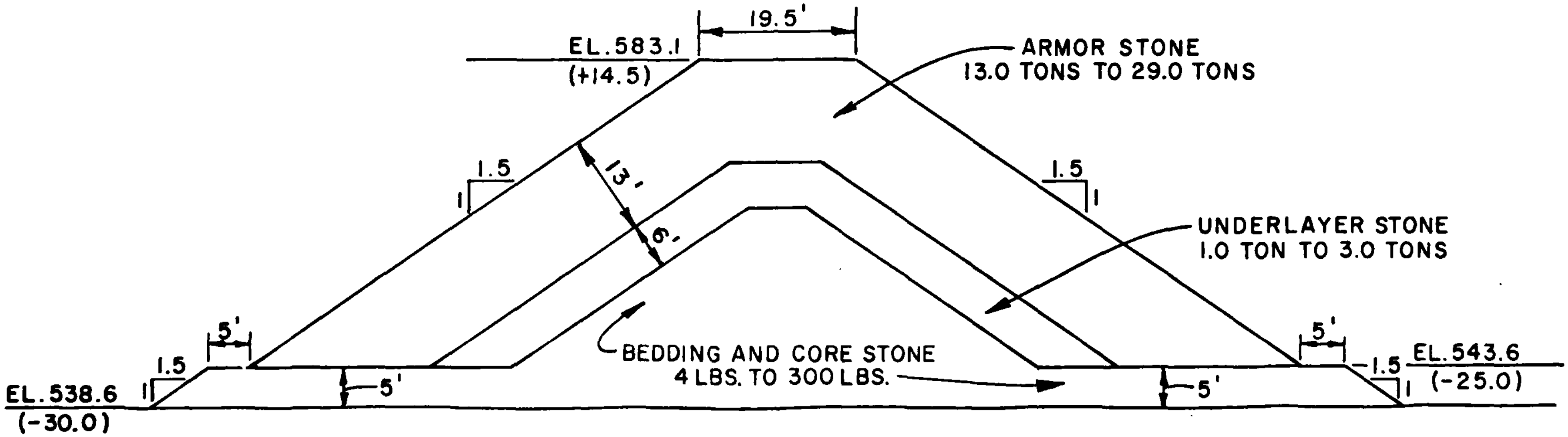
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

SEISMIC ZONE MAP

U.S. ARMY ENGINEER DISTRICT BUFFALO

FIGURE E1

FIGURE E1



TYPICAL BREAKWATER SECTION

SCALE: 1" = 20'

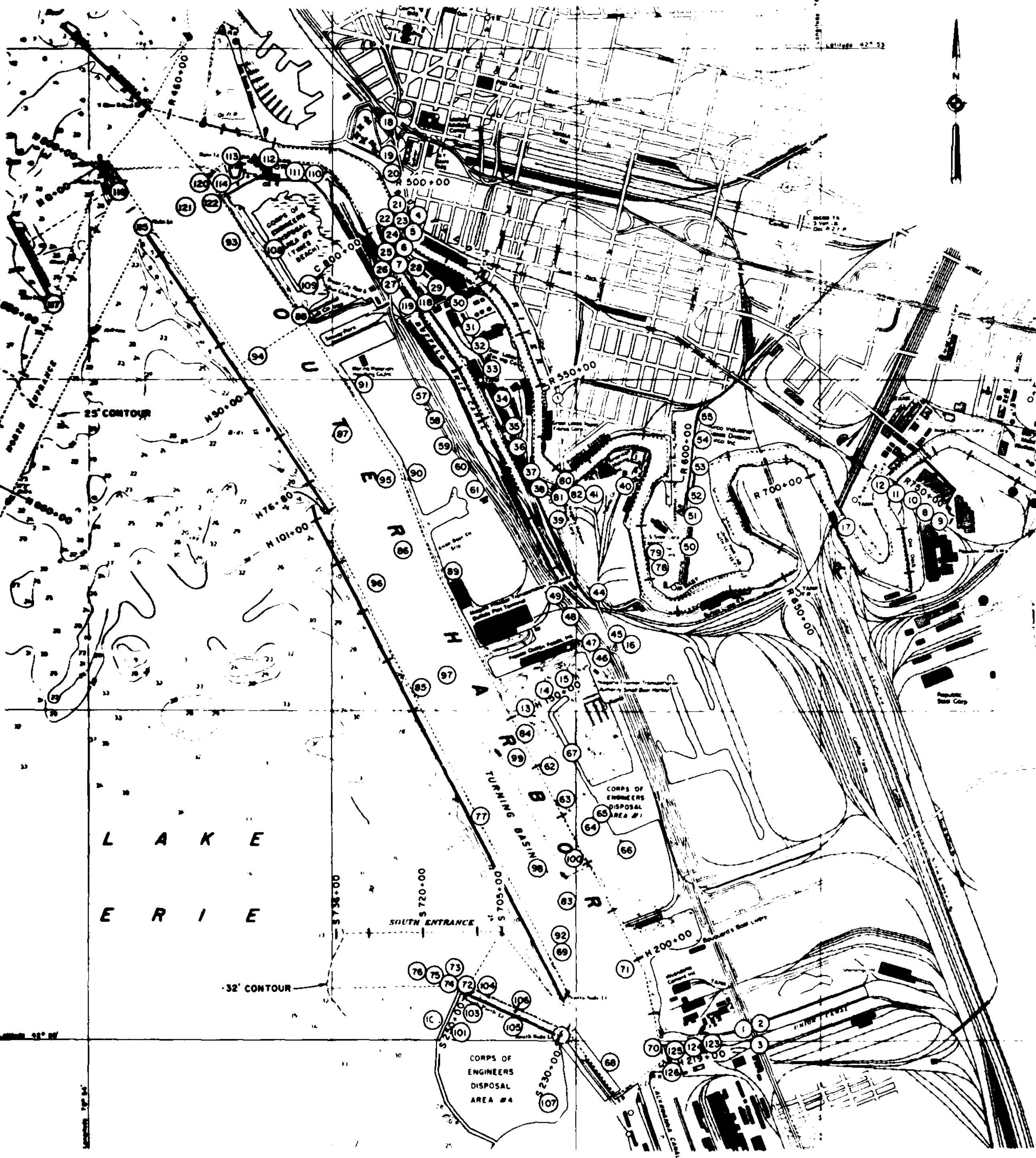
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

TYPICAL BREAKWATER SECTION
FOR STRUCTURAL MODIFICATIONS

U.S. ARMY ENGINEER DISTRICT, BUFFALO

FIGURE E2

FIGURE E2



STATIONING LEGEND

LOCATION	STATIONS
R - BUFFALO RIVER	R460+00 - R788+80
C - BUFFALO SHIP CANAL	C800+00 - C854+50
H - OUTER HARBOR	H0+00 - H76+80
	H101+00 - H219+00
N - NORTH ENTRANCE CHANNEL	N800+00 - N860+00
S - SOUTH ENTRANCE CHANNEL	S230+00 - S250+00
	S705+00 - S736+00

PLAN

SCALE OF FEET

1000 0 1000 2000 3000

NOTE:
BASE MAP WAS TAKEN FROM NOAA CHART NO 14833

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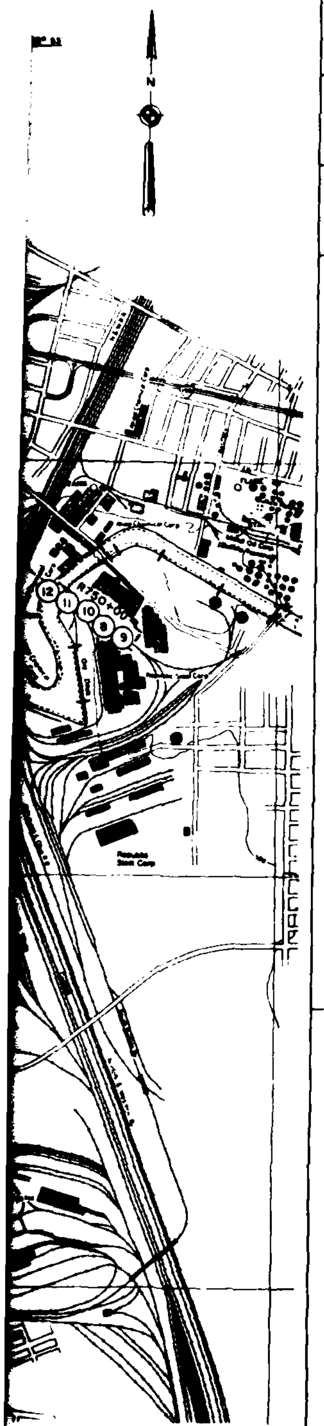
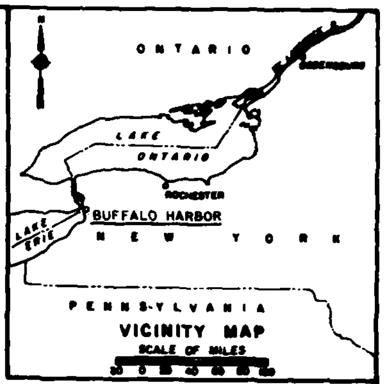
TABLE OF BORINGS			
NO.	SOURCE	STATION*	OFFSET
1		H219+00	1600' L
2		H217+00	1700' L
3		H214+00	1300' L
4	NYSDOT	R508+50	150' R
5		R511+50	125' L
6		C806+50	100' R
7		C809+00	150' L
8		R749+20	600' L
9		R749+20	450' L
10	CONRAIL	R749+20	300' L
11		R749+20	175' L
12		R749+20	145' L
13	BUFFALO	H149+50	1000' R
14	RIVER	H149+00	1450' R
15	IMPROVEMENT	H148+50	1850' R
16	CORP.	R625+00	900' L
17		R710+60	120' L
18		R497+00	1150' R
19		R500+00	700' R
20		R501+00	450' R
21		R507+00	150' R
22		R507+75	0
23		R508+75	100' L
24		R510+00	250' L
25		C805+00	50' R
26		C805+75	100' L
27		C807+50	150' L
28		C810+00	300' R
29		R520+00	450' L
30		R526+20	460' L
31		R530+00	700' L
32		R539+60	700' L
33		R544+00	700' L
34		R549+00	675' L
35		R558+00	400' L
36		R562+00	375' L
37		R565+50	200' L
38	BUFFALO	R570+00	350' L
39	SEWER	R573+00	800' L
40	AUTHORITY	R630+70	400' L
41		R575+75	360' L
44		R621+00	900' L
45		R623+00	900' L
46		R625+00	1500' L
47		R622+00	1500' L
48		R621+50	1500' L
49		R620+00	1700' L
50		R636+00	1000' R
51		R670+00	750' R
52		R671+50	650' R
53		R676+00	550' R
54		R620+00	700' R
55		R682+50	800' R
57		C830+00	950' L
58		C835+50	950' L
59		C840+60	950' L
60		C846+00	800' L
61		C851+00	700' L
62		H160+50	850' R
63		H167+50	850' R
64		H174+00	1150' R
65		H174+00	1400' R
66		H181+00	1900' R
67		H160+50	1300' R
68		H217+50	650' L
69		H191+70	450' L
70		H216+20	200' R
71		H200+40	400' R
72		S713+00	500' L
73		S715+00	450' L
74		S717+00	400' L
75		S719+00	300' L
76		S721+80	200' L
77		H163+75	700' L
78		R617+00	250' R
79		R615+40	140' R
80		R573+50	100' L
81		R573+00	200' L
82		R574+00	200' L
83		H184+50	50' R
84		H164+00	750' R
85		H136+00	500' L
86		H112+75	300' R
87		H65+00	200' R
88		H40+30	700' R
89		H121+00	900' R
90		H101+25	1140' R
91	USAED	H59+00	900' R
92	BUFFALO	H190+00	400' L
93		H25+00	350' R
94		H40+50	350' L
95		H70+50	250' R
96		H116+00	400' L
97		H137+00	0
98		H178+60	175' L
99		H156+30	390' R
100		H178+80	450' R

TABLE OF BORINGS			
NO.	SOURCE	STATION*	OFFSET
101		S250+00	1100' L
102		S718+00	1100' L
103		S748+00	500' L
104		S747+50	100' L
105		S240+00	500' L
106		S240+00	100' L
107		H217+50	1900' L
108		H30+00	1100' R
109		H40+02	1100' R
110		R487+50	200' L
111	USAED	R484+00	200' L
112	BUFFALO	R479+20	200' L
113		R473+20	300' L
114		H10+52	300' R
115		H14+00	850' L
116		H0+55	850' L
117		N326+00	500' R
118		C817+00	110' R
119		C817+00	100' L
120		H12+50	500' R
121		H15+00	0
122		H17+00	450' R
123		H217+00	800' L
124	BETHLEHEM	H217+00	500' L
125	STEEL	H217+00	200' L
126	CORP.	H219+00	200' L

* SEE STATIONING LEGEND





LEGEND

(43) INDICATES SUPPLEMENTAL BORING DESIGNATION FOR THIS PROJECT

17 INDICATES SOUNDINGS IN FEET TAKEN BY THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION IN 1981.

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO THE LOW WATER DATUM (L.W.D.) 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (I.G.L.D. 1955) (INTERNATIONAL GREAT LAKES DATUM 1955).
2. THE LOCATIONS OF DRIVE SAMPLE BORINGS ARE NOT DRAWN TO SCALE.
3. STATIONING PROVIDES AN APPROXIMATION OF THE DISTANCE BETWEEN POINTS. IT IS PROVIDED HERE MAINLY AS A REFERENCING MECHANISM.
4. SOUNDINGS SHOWN ON THIS PLATE ARE FOR SOFT BOTTOM MATERIAL. ACTUAL DEPTHS IN HARD MATERIAL WOULD BE ONE FOOT DEEPER.

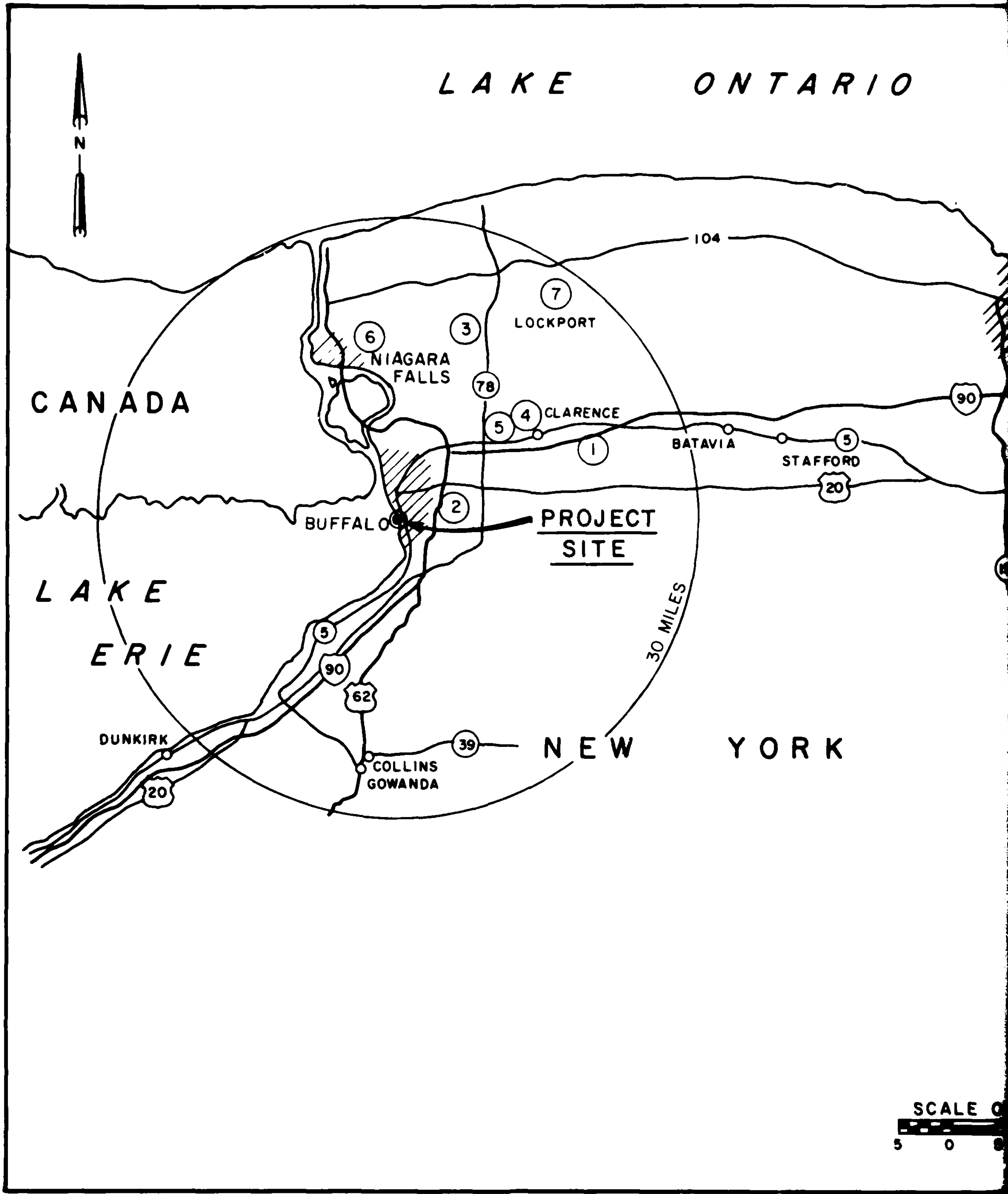
BUFFALO HARBOR STUDY
BUFFALO NEW YORK

PLAN OF
SUBSURFACE EXPLORATIONS

U.S. ARMY ENGINEER DISTRICT, BUFFALO

1 2

PLATE E1


LAKE ONTARIO
N
104
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LOCKPORT
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NIAGARA FALLS
78
CANADA
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4
CLARENCE
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BATAVIA
5
STAFFORD
20
2
BUFFALO
PROJECT SITE
LAKE ERIE
30 MILES
5
90
62
DUNKIRK
39
NEW YORK
COLLINS
GOWANDA
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SCALE
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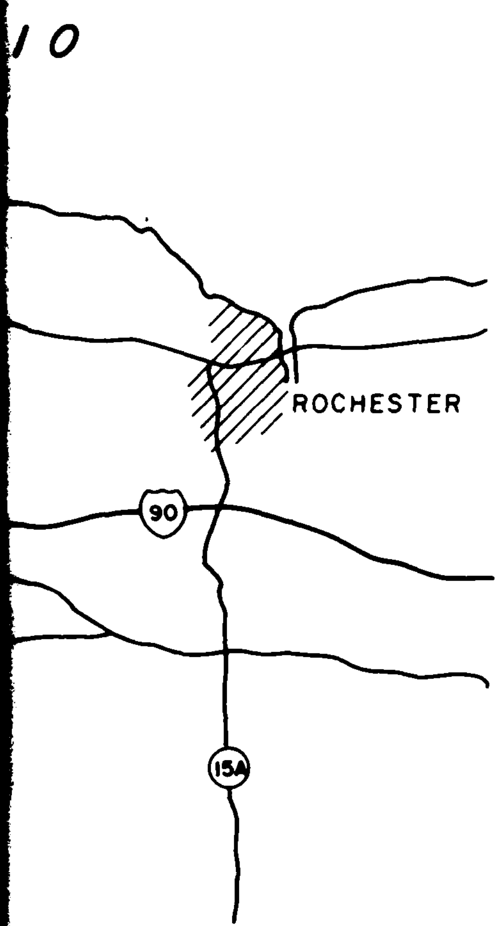


NOTES:

1. ② NUMBER IN CIRCLE INDICATES QUARRY SITE.
2. FOR QUARRY NAMES AND PRODUCTS, SEE PLATE F11

SCALE OF MILES

5 0 5 10 15

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

LOCATION MAP
POSSIBLE MATERIAL SOURCES

U.S. ARMY ENGINEER DISTRICT BUFFALO

2

MAP SUPPLEMENT SHEET
SUMMARY OF POSSIBLE SOURCES FOR
CONSTRUCTION MATERIALS

SITE NUMBER	SOURCE	QUARRY OR PIT LOCATION	RADIAL DISTANCE (IN MILES)	ARMOR STONE	UNDERLAYER STONE	BEDDING AND CORE STONE	RAILROAD BALLAST
1.	COUNTY LINE STONE CO.	AKRON, N.Y.	23		X	X	X
2.	BUFFALO SLAG CO.	CHEEKTOWAGA, N.Y.	7				X
3.	GENSTAR STONE PRODUCTS CO.	LOCKPORT, N.Y.	23	X	X	X	X
4.	LANCASTER STONE PRODUCTS CO.	CLARENCE, N.Y.	19	X	X	X	X
5.	BUFFALO CRUSHED STONE CO.	CLARENCE, N.Y.	17				X
6.	NIAGARA STONE PRODUCTS	PLETCHERS CORNERS, N.Y.	19				X
7.	ROYALTON STONE PRODUCTS	GASPORT, N.Y.	30	X	X	X	X

, 2

NOTES:

ARMOR STONE - 13-29 TON

UNDERLAYER STONE - 1-3 TON

BEDDING AND CORE STONE - 4-300 LB.

RAILROAD BALLAST NYSDOT NO. 3A - 1"-1 1/2"

X-INDICATES QUARRY CAPABLE OF PRODUCING STONE INDICATED.

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

MATERIAL SURVEY
SUMMARY OF SOURCES

U.S. ARMY ENGINEER DISTRICT BUFFALO

PLATE E3

3

APPENDIX F
PERTINENT CORRESPONDENCE
AND
NEWS ARTICLES

BUFFALO HARBOR, NY

STAGE II
PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

APPENDIX F
CORRESPONDENCE

EXHIBIT	DESCRIPTION
F-1	7 October 1982 letter from Mr. John Bunce of the Independent Cement Corporation supporting the Buffalo Harbor Study and Alterntive Plan IIIh.
F-2	1 July 1982 letter from Mr. John F. Downing of the Niagara Frontier Transportation Authority regarding the Port Authority's intent to act as the local cooperator for the Buffalo Harbor Study.
F-3	14 October 1981 letter from the Port of Buffalo, Niagara Frontier Transportation Authority supporting the Buffalo Harbor Study.
F-4	13 October 1981 letter from Mr. Kauppi of International Multifoods expressing considerable interest in the Buffalo Harbor Study.
F-5	7 January 1981 letter from Bethlehem Steel Corporation, Great Lakes Steamship Division, Cleveland, OH, expressing interest in the Buffalo Harbor Study and support for improvements to the South Entrance Channel.
F-6	17 December 1980 letter from Mr. Louis E. Ervin of the American Steamship Company expressing interest in improving the South Entrance Channel.
F-7	22 September 1982 article from the Buffalo Evening News regarding Bethlehem Steel's Lackawanna Plant.
F-8	26 May 1982 article from the Buffalo Evening News announcing the indefinite closure of the Republic Steel Plant.
F-9	19 April 1982 article from the Buffalo Courier Express regarding Bethlehem Steel's Lackawanna Plant.
F-10	16 January 1982 article from the Buffalo Evening News announcing the indefinite closure of Hanna Furnace.

INDEPENDENT CEMENT CORPORATION
POST OFFICE BOX 10
BUFFALO, NEW YORK 14218
(716) 825-4110
NEW YORK TOLL FREE (800) 462-8800

October 7, 1982

Mr. Thomas Switala
Planning Division
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207

Dear Sir:

Regarding your Buffalo Harbor study we feel it's extremely important to the economy of Buffalo these studies continue to a final conclusion with a viable plan.

Our waterfront which is one of the finest on the Great Lakes has suffered tremendously the last few years due to various economic situation.

We of course feel the alternative plan 111h which would use our facility is the most practical and the one of the least expensive. It would help industries located on and near the waterfront.

Once again we must stress Industry and Government agencies must use every effort to see this study to a conclusion. This is necessary for the economic growth of the Buffalo waterfront.

Respectively,

John Bunce

John Bunce
Terminal Manager

JB/cp

ICC
A "Holderbank" Group Company

Exhibit F-1

NIAGARA FRONTIER TRANSPORTATION AUTHORITY
181 ELLICOTT STREET • P.O. BOX 5008 • BUFFALO, N. Y. 14205 • AREA CODE 716, 855-7300

July 1, 1982

Colonel George P. Johnson
U.S. Army Corps of Engineers
District Office
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

Please be advised that the Niagara Frontier Transportation Authority is in support of the continued funding for the Army Corps of Engineers' Buffalo Harbor Study.

As the local cooperator for this study, we have a keen interest in this effort and desire expeditious action be taken to complete pre-authorization planning on this project as soon as possible.

Sincerely,

JOHN F. DOWNING
Executive Director

JFD/SMW/cp

PORT OF BUFFALO

NIAGARA FRONTIER TRANSPORTATION AUTHORITY

901 FUHRMAN BLVD. • BUFFALO, NEW YORK 14203 • 716-855-7411

October 14, 1981

George P. Johnson
Colonel, Corps of Engineers
District Engineer
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Johnson:

I am delighted to respond to your letter of October 8, 1981 in which you outlined your study of the Buffalo Harbor and requested assistance from the staff of the Seaport Division of the Niagara Frontier Transportation Authority. We are very supportive and enthusiastic about the study and stand ready to assist you in any way possible.

Please contact Mr. David Stock in regards to any information you require about the Port facilities. If you feel that I could be of assistance to you personally, please don't hesitate to contact me at any time.

I believe sincerely that it is axiomatic that we here at the Port do everything possible to implement the facilities here to reduce transportation and handling costs of raw materials to the industries of Buffalo that form the bedrock of this community.

Have a good day.

Sincerely yours,

Noel Painchaud

Noel C. Painchaud
General Manager

NCP:sal

Exhibit F-3

INTERNATIONAL MULTIFOODS
P. O. BOX 944
BUFFALO, NEW YORK 14240
(716) 849-1616

INTERNATIONAL MULTIFOODS

October 13, 1981

Mr. George P. Johnson
Colonel, Corps of Engineers
District Engineer
Department of the Army
1776 Niagara Street
Buffalo, NY 14207

Dear Mr. Johnson:

In response to your letter of October 8, data needed on our marine facilities can be obtained by contacting me. We can direct inquiries to appropriate individuals as necessary.

For your information, our marine dock handles more inbound grain than any other in the Buffalo Harbor.

We are watching the progress of the studies of the Buffalo District by the US Army Corps of Engineers with considerable interest.

Sincerely,

K.O. Kauppi

K. O. Kauppi
Plant Manager

amv

Exhibit F-4

Bethlehem Steel Corporation

GREAT LAKES STEAMSHIP DIVISION
SUITE 2001 – 55 PUBLIC SQUARE
CLEVELAND, OH 44113

R. F. DOBSON
MANAGER

IN REPLY REFER TO
GD STUDIES -
Buffalo Harbor

BETHLEHEM STEEL

January 7, 1981

Mr. Charles E. Gilbert
Chief, Manning Branch
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Sir:

Subject: BUFFALO HARBOR STUDY

We wish to thank you for the informative review of subject study with your staff at your Buffalo offices recently and the opportunity to discuss the study with you.

Great Lakes Steamship Division is very interested in your project in view of the high volume of tonnage which we put into the Port of Buffalo each year for our BETHLEHEM STEEL CORPORATION, Lackawanna Steel Facility, carried not only in our company owned vessels, but in other United States and Canadian flag vessels. Most particularly, we are interested in your alternative number 11 and recommend that careful consideration of that alternative be addressed in the study.

We feel those considered changes encompassed in alternative number 11 would greatly improve the south entrance to Buffalo Harbor and allow a safer and more expeditious transit for all vessels.

Exhibit F-5

Bethlehem Steel Corporation

Mr. Charles E. Gilbert
Chief, Planning Branch

January 7, 1981
Page 2

Please keep us advised as the Buffalo Harbor Study progresses.

Very truly yours,

BETHLEHEM STEEL CORPORATION
Great Lakes Steamship Division

K F Dobson
Manager

CGD:llb

AMERICAN STEAMSHIP COMPANY
A SUBSIDIARY OF GATX CORPORATION
3250 MARINE MIDLAND CENTER
BUFFALO, NEW YORK 14203

December 17, 1980

Col. George P. Johnson
District Engineer
Department of the Army
Buffalo District Corps of
Engineers
1776 Niagara St.
Buffalo, NY 14207

Dear Col. Johnson:

As you know, American Steamship Company is one of several operators on the Great Lakes that has ships 1,000 feet in length. Our ships are the BELLE RIVER and INDIANA HARBOR.

We have put both of these ships into the Bethlehem Steel Plant at Lackawanna using the south entrance. Several other companies have done the same.

Depending upon the wind conditions existing at the time of arrival, we have experienced delays in entering and docking particularly if there are other ships in the Bethlehem docks.

Therefore, we are interested in having the Corps of Engineers investigate the possibility of making improvements to the outer harbor at Buffalo so that the delays we have experienced could be minimized thereby making a savings to us and our customers.

Sincerely,

Louis E. Ervin
Vice President
Marine Personnel

daa

Exhibit F- 6

BEN 9/22/82

Bethlehem Closing West Coast Plants

In a move that appears to brighten the future of Bethlehem Steel Corp.'s Lackawanna plant, the company on Tuesday announced plans to discontinue its West Coast operations and put its Los Angeles and Seattle plants up for sale.

The Los Angeles plant, like the Lackawanna facility, has been a well publicized money loser. Also like Lackawanna, it has been frequently mentioned by industry analysts as a prime candidate for shutdown.

Bethlehem spokesman Henry H. Von Spreckelsen today would not comment on what impact, if any, the West Coast shutdown would have on the Lackawanna facility.

"Our position on Lackawanna is the same as we've expressed it over many, many months," he said.

"Our aim is to make Lackawanna profitable and viable and we're working toward that," Mr. Von Sprecklesen said.

He said Bethlehem plans to put both the Los Angeles and Seattle mills up for sale. The Los Angeles plant will stop producing steel by the end of the year, if no buyer is found. The Seattle plant, which is profitable, may continue in production if no buyer is found, he said.

Both plants are much smaller than the Lackawanna facility. The Los Angeles mill has a production capacity of about 450,000 tons a year, and the Seattle mill has capacity of about 500,000 tons. These compare with Lackawanna's 3.5 million tons.

Both Los Angeles and Lackawanna often have been mentioned as among the top problem plants of the nation's second-largest steel company.

At a meeting of security analysts in March, Bethlehem chairman Donald H. Trautlein, said the company was "addressing the problems of our (Los Angeles) plant very, very closely."

"It's a plant that, like out Lackwanna plant, has been a problem. And we intend to, within the next year or so, either determine that we can be reasonably profitable there or do something else," Mr. Trautlein said in March.

In May, the Lcakawanna and Los Angeles plants both appeared on a list of "steel plants that will close or are in jeopardy," published by Business Week magazine.

The Lackawanna plant was said to be set to close "before end of decade" and mentioned that the company is "planning no capital improvements." The remarks were those of the magazine and not of the steel company.

On Aug. 27, the Value Line Investment Survey, one of the nation's most widely-read advisory services, said it "wouldn't rule out the possibility" that Bethlehem might close the Lackawanna or Los Angeles plant.

In Bethlehem's Tuesday announcement, the company said the divestiture of the West Coast operation will allow it to concentrate on modernizing other mills at Sparrows Point, Md., Burns Harbor, Ind.; and Bethlehem and Steelton, Pa. The company did not include its other steel plants at Lackawanna or Johnstown, Pa. in that list.

Exhibit F-7

Buffalo Evening News/Wednesday, May 26, 1982

Republic Steel Lays Off 275; Will Close South Buffalo Plant

By ROBERT J. SUMMERS
News Financial Reporter

Republic Steel Corp. laid off most of the remaining workers at its South Buffalo plant Tuesday and said the mill will be closed indefinitely because of poor business conditions.

The latest layoffs sent 275 white-collar workers to the unemployment rolls, and leaving only 15 to 20 security and maintenance people at the big South Park Avenue facility.

The layoffs — the latest in a series of local and national cutbacks resulting from one of the severest slumps in steel industry history — came as no big surprise.

Cleveland-based Republic has been stung hard by the recession. The Buffalo plant, which makes products mainly for the auto industry, stopped making raw steel last August and had not rolled any finished products since February.

A Republic spokesman said "there is hope" the plant, which once employed 2,500 workers, would reopen when business picks up. But no one is predicting when that might be.

The company recently spent about $20 million on modernization and anti-pollution equipment at the Buffalo plant.

The spokesman said the Buffalo plant is the only one of Republic's six facilities to be completely closed. He said about 7,300 Republic employees have been laid off throughout the company.

The company said the 275 salaried employees will be laid off within 30 days. It attributed the cutback to "current depressed conditions in the steel business associated with the high interest rate recession, which continues to be aggravated by the disproportionately high level of steel imports."

Republic lost $28.5 million during the first three months of 1982 as sales fell to $880 million from $1.1 billion a year ago.

The company has not forecast second quarter results, but if they follow industry trends, another loss is expected.

The industry blames its current problems mainly on a lack of orders from manufacturers of autos, appliances, capital equipment and other products, plus unfair competition from Japanese and European manufacturers that are subsidized by foreign governments.

According to the American Iron and Steel Institute, imports for the first quarter of 1982 were up almost 35 percent from a year ago. Imports captured almost 23 percent of the U.S. market in the quarter, the institute said.

In the first week of May, the nation's steel mills operated at less than half their capacity, an all-time low for non-strike periods.

Exhibit F-8

Courier-Express Business

Update: Bethlehem Steel

Lackawanna Steel Mill's Future Is Still Unclear

BY BILL CALLAHAN
Courier-Express Staff Reporter

COURIER-EXPRESS / ED ZAGORSKI

THE LACKAWANNA plant of the Bethlehem Steel Corp. has been a plant in crisis for more than a decade.

After struggling through two major cutbacks in the 1970s, which reduced the once second-largest steel plant in the country to 11th or 12th biggest, the Lackawanna plant is still in a sensitive position in the overall strategy plans of the parent corporation.

Company officials are reluctant to talk publicly about the plant and its future except in broad terms. Nevertheless several recent developments have been cause for concern for steelworkers and the area as a whole.

In February the company announced *that it plans to close* its 21-inch bar mill affecting about 150 workers. At the beginning of the year the iron foundry and the related pattern shop were closed affecting another 45 workers.

THEN LAST MONTH when it looked like Bethlehem was about to proceed with a multi-million project to refurbish its No.9 coke oven battery and install new pollution controls, the company announced that it was deferring the project and would shut down the coke oven battery later this year. About 80 workers will be affected.

In conjunction with that annoucement, the company also reported that it was taking its lime plant out of service in the near future affecting another 14 workers.

At the same time, on a more positive note the company said it will keep the two sinter lines, which feed the plant's blast furnaces with iron bearing materials, in operation and is fitting them with additional pollution *controls costing a total of $17 million.*

In making the combined announcement on March 4, Bethlehem said it was taking "further steps to reduce costs at its Lackawanna plant. In a follow up to that announcement, Marshall Post, Bethlehem's corporate manager for media news, said those moves were being made to "ensure the future viability of the Lackawanna plant."

JUST WHAT IS the viability of the plant? Much depends on the future of the Bethlehem Steel Corp. and the entire steel industry.

Bethlehem Steel, second only to U.S. Steel Corp. in steel production, like the rest of the industry is looking ahead to the 1980's and gearing up to meet the widespread changes to keep its place in the backbone of the American economy.

In the corporation's 1980 annual report, Bethlehem's new chairman, Donald H. Trautlein, wrote "looking ahead, we have intensified our strategic planning efforts in order to help determine Bethlehem's long-term future. These efforts touch every area of our business. We anticipate that many of the studies involved will be completed in 1981."

There is no question that the Lackawanna plant operations are an integral part of those studies. Queries for personal interviews with top Bethlehem executives about the Lackawanna plant and its future were termed "premature at this time." However, responses were received to a series of submitted questions.

1980 WAS NOT a good year for Bethlehem Steel Corp. Although the corporation had earnings of $122 million or $2.77 a share on sales of $6.7 billion, this was a sharp drop from earnings of $257.7 million or $6.31 a share on sales of $7.1 billion in 1979.

When asked if the Lackawanna plant now is a profitable operation, the company replied "No, not under present economic conditions." The amount of the 1980 loss at the Lackawanna plant was not disclosed.

The first major signs of problems at the Lackawanna plant came in 1970 when it appeared that the corporation was considering closing the Lackawanna operation. At that time the company contended its major problems were taxes, environmental costs and productivity.

The company did receive some tax relief and other benefits shortly thereafter. *Bethlehem then followed* through with the construction of a new 13-inch bar mill at the Lackawanna plant at a cost of $143 million. The mill is still considered the largest and most sophisticated in the industry.

HOWEVER, BETHLEHEM is still fighting the tax battle claiming the taxes are still too high for the Lackawanna plant and are more than twice the property taxes paid by any other Bethlehem plant.

The company stated "This is attributable, at least in part, to the value placed on the plant for property tax purposes by the City of Lackawanna that we believe is excessive. We have proceedings pending in the Supreme Court of Erie County asserting that the assessments for 1978, 1979 and 1980 are too high and should be reduced."

Like all heavy industry, the Lackawanna plant has had major environmental problems but has made good strides in the last 10 years to overcoming a large portion of the problems through heavy investment.

"Environmental controls continue to be a major cost element at the Lackawanna plant," the company said. "Capital spending from 1970 through 1980 for environmental control was more than $82 million. Reductions in plant operations have reduced the amounts which otherwise would have been required. Nevertheless, substantial future expenditures may be necessary to meet air, water and solid waste requirements."

THE COMPANY ALSO replied that capital expenditures at Lackawanna, including its environmental costs, have exceeded $560 million for the period between 1970 and 1980.

When asked about productivity at the plant today, the company answered "productivity has improved slightly at the Lackawanna plant in recent years."

That statement doesn't set too well with the unions representing steelworkers at the Lackawanna plant. They feel that productivity has increased greatly at the Lackawanna plant and is not a problem.

"The problem isn't productivity," said Joseph Haefner, chairman of the plant committee at the Lackawanna plant and an official of Local 2603, United Steelworkers of America union (USWA)

"We feel the corporation has a policy of stagnation as far as this plant is concerned," said Haefner, " they don't want to spend their profits and

Exhibit F-9

Pg 2 of 2

& Industry

Sun beams through a skylight help brighten the 79-inch Hot Strip Mill, left, at Bethlehem's Lackawanna plant. John S. Slurtek, above, checks the controls in the computer room of the plant's Basic Oxygen Furnace Shop.

pump money and work into this plant. They consider this a swing plant."

ABOUT THE PLANT not being profitable, he said "with a plant as large as this it is extremely difficult to make a profit when you have cut out 90 percent of its products."

"When they talk about the price of steel costing $6 a ton more at this plant than their other plants, we have been trying for 10 years to get a breakdown of our costs versus the cost at other plants. We don't know how they arrive at that figure," he said.

Haefner added "steelworkers are proud people. They want to work. They don't want to go on welfare or get help from some other government agency. The labor people don't know what to do. The people are discouraged, they don't know what is going on from day-to-day."

Steelworkers have seen their ranks dwindle at the Lackawanna facility from an average annual high of 19,500 in 1956 to a low of 7,000 in 1980. During this same period, annual raw steel production reached a high of 6.6 million ingot tons in 1966 and a low of 1.7 million ingot tons in 1980.

IN THE LATE *1960's the* Lackawanna plant had a rated capacity of 6.8 million tons annually and employment was in the 17,000 to 19,000 range. However, following an unprofitable period for the plant, the capacity was reduced to 4.8 million tons in 1971 and employment dropped to the 11,500 to 12,500 range.

Another jolt came in 1977 when Bethlehem announced it was cutting the Lackawanna capacity to 2.8 million tons annually and employment to the 8,500 range. However, the capacity of the plant was not reduced to the 2.8 million ton level but has been kept at a rated 3.5 million tons. That doesn't mean the plant produces 3.5 million tons, but it has kept the capacity to produce that much steel if demand increases.

The Lackawanna plant was not alone in that cutback. Bethlehem that year "bit the bullet" and wrote off a total of $750 million worth of what it considered obsolete facilities in its operations. But the bulk of the write-off came at Lackawanna and Johnstown, Pa.

The Lackawanna plant is heavily tied to the automotive business and that, in part, was responsible for its poor showing in 1980.

THIS IS THE WAY the company describes its products, markets and long range plans.

"The Lackawanna plant's product mix includes hot rolled carbon and alloy bars and cold rolled and galvanized sheet metal."

"The principal markets served include cold finished bar products, fasteners and the automotive market for bars, and the steel service centers and automotive markets for sheet steel. Also, Lackawanna fabricates cold formed shapes from various applications and produces a number of highway products."

It is presently anticipated that Lackawanna will continue to be a producer of these products."

Although the labor people and management may disagree on many things at the Lackawanna plant, they are united one one thing — The Buy American Steel Bill — and their dissatisfaction with Gov. Carey's recent veto of the latest amendment to the bill which would expanded the coverage of the 1980 legislation to include major projects in the state.

"THAT BILL COULD mean a lot of work for this plant and might even bring about the reopening of the structural steel mill," Haefner said. That mill was one of the major casualties in the 1977 cutback.

The problems of Bethlehem Steel and the steel industry as a whole are widespread particularly in the generation of capital for investment as well as seeking goverment protection from foreign steel imports.

In a recent story in Forbes Magazine, Trautlein was quoted as saying "You can get enforcing of dumping laws in Canada. They went after the Europeans right away and boy, they don't take any time to tell them to straighten up. Look at Canada's tax laws, too Stelco built this plant at Nanticoke and wrote it off after 2 years. We have to write ours off over 12. So from the standpoint of taxes, they can recycle their capital 6 times as fast. Why can't we have those kinds of laws?"

The $749 million Stelco plant at Nanticoke on the shores of Lake Erie is only 80 miles from Buffalo and eventually could become another source of serious competition to the Lackawanna plant.

THE LACKAWANNA PLANT got a reprieve from another source of serious competition when the U.S. Steel Corp. shelved plans until at least the late 1980's for a new major steel plant at Conneaut, Ohio, on the southern shore of Lake Erie.

Another Bethlehem Steel executive had more encouraging words about the future of the steel industry in a recent speech here.

Bruce E. Davis, assistant vice president-public affairs, said "I sense that before the end of summer we are going to see significant changes in the tax laws of this country. We are going to see from that in the 1982-1983 period a significant increase in investment."

"I don't doubt that by 1985 we will see a revitalized American automobile industry and a couple of years after that we will see a significant and revitalized American steel industry including some investment in our New York State facilities," Davis said.

The Lackawanna plant is Bethlehem's only New York State plant.

Next month, on May 12, Walter F. Williams, president of Bethlehem Steel, will be the main speaker at the annual director's election luncheon of the Buffalo Area Chamber of Commerce. Whether he'll have any more news — specifically good news — remains to be seen.

Operations Shutdown Since 1970

Coke batteries 3, 4, 5 and 6; blast furnaces A, B, and G; scrap melter; No.2 and No.3 open hearth furnaces; 54/48-inch structural mill; 28-inch structural mill; 14-inch structural mill; 8-inch and 10-inch bar mills; tie plate and splice bar shop, 32-inch rail mill, 40-inch blooming mill and the pattern shop and iron foundry.

Current Operations at the Lackawanna Plant

Coke batteries 7, 8, and 9 (9 to shut down later this year); blast furnaces C, F, H, and J, basic oxygen furnace (3 vessels) shop; 44/30 21-inch mill; billet preparation; 45-inch slabbing mill; hot strip mill; 12 inch and 13-inch bar mills (12-inch mill to close later this year), pickler; cold strip mill, sinter plant and galvanizing mill.

BEN 1-16-82

A Grim Day at Hanna Furnace

By MARGARET SULLIVAN

If Frank Jolliffe had the money, he could spend millions and millions of dollars modernizing the Hanna Furnace plant on Fuhrmann Boulevard.

But it wouldn't make a bit of difference, the company president says.

Unlike much of the local steel-related industry, Hanna's problems — which resulted in Friday's announcement of a plant shutdown — have little to do with the age and condition of the facility, even though the plant has been running since 1900.

"Yes, it's an old plant, but that's not the issue," Mr. Jolliffe says, explaining the closing that will idle 350 workers for an indefinite period of time. "If I had it all automated today, I still couldn't sell anymore."

The problem is demand.

"Our foreign competitors are underselling us — the import situation is destroying the American pig iron business," Mr. Jolliffe says. There was a time when the United States pig iron industry sold eight million tons a year. Now it's down to 800,000 tons and falling.

WITH ONLY that much being sold annually in the whole country, Hanna Furnace now has more than 200,000 tons of excess pig iron inventory outside its South Buffalo plant.

"You want to know what pig iron looks like?" Mr. Jolliffe asks. "Just take a drive out to the plant. It's everywhere."

Not only has the problem with cheap imported iron hurt Hanna Furnace, but the general economic conditions of the country have taken their toll, Mr. Jolliffe says.

For instance, Shenango Corp., Hanna's neighbor on Fuhrman Boulevard and one of its best customers for years, has suffered the same lack of demand and has stopped ordering the company's iron. Similarly, the closings of foundries all over the country — like Buffalo's Pratt & Letchworth — have hurt Hanna, a supplier of their materials.

The closing of Hanna Furnace is no surprise to followers of the industry. There once were 22 pig iron manufacturers in the United States — now there are four.

"Hanna is the last in New York State," Mr. Jolliffe says, noting that the plant may gear up again in nine months, but admitting that a permanent closing probably will occur if the economic and import situations do not change substantially.

A spokesman for Hanna Furnace's employees says the mood among workers is grim.

"Everyone is depressed — especially because there's nothing left out there to hope for," says Joseph Carr, an electrician at Hanna and the president of United Steelworkers Local 2497.

What makes matters worse, Mr. Carr says, is the dearth of supplemental unemployment benefits from Hanna's parent company, National Steel Corp. of Pittsburgh.

THOSE WORKERS who have been at Hanna less than 20 years will receive no supplemental benefits, which means that the total they will receive in unemployment benefits will be $125 a week, Mr. Carr said.

"This is going to be an extreme hardship on these people," Mr. Carr says, explaining that shutdowns of other National Steel plants has sucked dry the corporation's resources for labor.

Those workers who have been at the company for 20 years or longer will receive about 70 percent of their pay for 26 weeks, Mr. Carr said.

About a third of the idled employees have been with the company for 20 years or more.

Hanna has been functioning on a limited basis for some time. While its peak employment in the early 1970's was close to 600, fewer than 400 have been working lately.

One of its two major blast furnaces has been shut down since July, 1979.

Several years ago, Hanna Furnace was the subject of a $14 million lawsuit by the federal government which accused the company of excessive emissions. But the case was dropped and Mr. Jolliffe says that environmental causes had nothing to do with the plant shutdown.

"The environmental requirements are something we would have to consider if we decided to start up again," Mr. Jolliffe says.

Exhibit F-10

APPENDIX G

PUBLIC INVOLVEMENT

BUFFALO HARBOR, NY

STAGE II

PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

APPENDIX G
PUBLIC INVOLVEMENT

Exhibit	Description
G-1	16 September 1982 Public Information Meeting - Summary Minutes.
G-2	14 July 1982 Harbor Users Workshop - Summary Minutes.
G-3	July 1982 News Update on the Buffalo Harbor Study.
G-4	January to May 1982 Interviews with Harbor Users.
G-5	23 October 1981 Newsletter on the Buffalo Harbor Study.

NCBPD-EB

MEMORANDUM FOR RECORD

SUBJECT: Buffalo Harbor Study Information Meeting Held 16 September 1982

1. A Public Information Meeting was held on the Corps Buffalo Harbor study on 16 September at 7:00 p.m. in the Auditorium of the Main Branch of the Erie County Public Library. A list of attendees is at Inclosure 1.

2. Mr. Charles Gilbert, Chief of the Planning Division of the Buffalo District, Corps of Engineers, opened the meeting by outlining the scope of the study, its purpose, and the purpose of the meeting. As stated by Mr. Gilbert, the meeting was being held to let the participants know about the alternatives identified so far and to solicit comments on them which would serve as a guide in future study efforts.

3. The Corps Planning and Implementation process was then described, as well as the purpose and duration of each activity. The Corps is now in Phase 2 planning. This is where the actual feasibility study is done.

4. The meeting was then turned over to Study Manager, Tom Switala. A brief historical overview of the Port of Buffalo was given with the emphasis placed on not only what Buffalo was, by why. Mr. Switala cited factors leading to the decline of Buffalo as a port, such as the increasing use of other modes of transportation, changing markets and technologies, and most important, the opening of the St. Lawrence Seaway. The following is a summary of the present Corps findings.

5. With the recent revival of interest in the waterfront, a number of projects have already been completed or are in the advanced stages of construction; i.e., the Erie Basin Marina, the Waterfront Housing and Office Developments, the Kelly Island Sewer project, and many more.

6. One of the major impediments to increased waterborne commerce is the narrow, winding channel of the Buffalo River, its' depth, and many bridge crossings. While there is heavy industry in the harbor area, much of it is not water oriented, thus the Inner Harbor is obsolete as a modern shipping facility. The land adjacent to Outer Harbor, while occupied by port-related industries, is still grossly underutilized and could easily acommodate more development, particularly if improvements were made.

7. It was in response to growing local interest in area redevelopment both commercially and recreation-wise that Congressman Henry Nowak was able to get a resolution passed authorizing the Corps to study the Buffalo Harbor

area as it is related to existing and potential development and associated impacts in the whole metropolitan area. Thus, the study has centered on the following water and land-related needs:

a. Commercial navigation improvements.

b. Water quality improvements.

c. Amount of annual maintenance dredging.

d. Development of transfer facilities.

e. Recreational opportunity enhancement.

f. Coordination of efforts.

g. Formulation of a debris removal program.

8. As part of the base case, it is further expected that over the duration of the planning period (50 years), the steel industry will rebound from its present low and the grain industry will remain in Buffalo.

9. As part of Stage 1 studies, four general categories of improvements were considered:

a. Deepening of the Bufflao River and ship canal for vessels up to 700 feet in length.

b. Transshipment of bulk commodities from the Outer Harbor to upriver facilities.

c. Alteration of the South Entrance of the Outer Harbor for safe, all-weather transit of 1,000-foot vessels.

d. Effects of revitalization efforts and the potential for the harbor area.

10. Mr. Switala then discussed what has occurred in Stage 2 planning and the alternatives which have developed. Since these alternatives are dealt with in detail in the information pamphlet mailed out prior to the meeting, elaboration will be omitted here. If you need copies of the pamphlet, they will be mailed upon request. A period of statements and questions from the audience followed. Among the topics were:

a. Who would bear the cost of work on the Lackawanna and Union Ship Canals?

b. Was an investigation done on renovating the old grain elevator near the South Entrance?

c. What is the quantity and nature of spoil material associated with the alternatives and where/how would this material be disposed of?

d. What effect would utilization of the rail spur on NFTA property have on bulk commodity transshipment?

e. How does the study impact on the future rehabilitation of the Father Baker Bridge?

f. Was the impact of a new Michigan Avenue Bridge considered? Changes in Route 5?

g. The changing status of Federal/non-Federal costs.

h. Have the alternatives considered the burgeoning marinas, recreational facilities, and other private developments?

i. The necessity of straightening the Buffalo River for the grain industry.

j. The beneficial effects of a unified planning effort.

k. Spinoffs of the plans, such as rebirth of small, diverse industry or transshipment of western coal.

l. Offshore islands for transshipment.

m. The boundaries of the study area.

n. Can the study be speeded up?

o. What is the length of navigation season assumed for the study.

p. Who would bear the costs associated with project benefits?

q. How have recent events in the local steel industry influenced our scenario?

r. How are project depths determined?

Thomas C Switala
THOMAS C. SWITALA

LIST OF ATTENDEES

Information Meeting - 16 September 1982

Sharon West, NFTA
Captain V. Noonan, Great Lakes Towing Company
John Bunce, Independent Cement Corporation
Roy Abrams Jr. Citizen
E. H. Flinchbaugh, Buffalo Corn Exchange
James R. Leverett Jr. P.E., Tifft Farm
Albert Scott, Gordon Provision Company
H. S. Bryd, Independent Cement Corporation
John Kearns, Representing Assemblyman Richard Keane
George Huber, Citizen
Robert Miller, Niagar Frontier Transportation Committee
Sheryl Bower, Citizen
Brian Starkey, Knowth Architect-Planners
D. Tarczynski, NYS Parks
Richard Van Derzee, Citizen
Jo Nasoff-Finton, Hatch Associate Consultants Inc.
John Battaglia, Citizen
Joseph F. Lombardo, Jr. Citizen
John G. Mathias Jr., RCR Yachts, Inc.
Joseph M. Tocke, NYS DOT
Kurst F. Hoctor, Roy Track Company Inc.
Charles Gilbert, Corps of Engineers
Thomas Switala, Corps of Engineers
Bruce Sanders, Corps
Joan Pope, Corps of Engineers
Roger Haberly, Corps of Engineers
Denton Clark, Corps of Engineers
Ambrose Andre, Corps of Engineers
Kathleen McDermott, Corps of Engineers
James Conley, Corps of Engineers
Philip Frapwell, Corps of Engineers
James Kaloustian, Corps of Engineers
Richard Broussard, Corps of Engineers

Inclosure 1

A meeting to inform the Buffalo Harbor users of the current status of the study was held at the Buffalo District office at 1:30 p.m., 14 July 1982. Inclosure one is a list of those in attendance.

Charles Gilbert, Chief of the Planning Division of Buffalo District opened the meeting by asking those present to introduce themselves. Afterwards, Mr. Gilbert stated the purpose of the workshop was to have an informal open discussion of the findings of the recent interviews that the Corps had with the individual harbor users and the resultant impacts on the study alternatives. Mr. Gilbert further stated that though we have limited attendance at this meeting to users only, there will be a larger public meeting of all concerned individuals, corporations and government representatives on 18 August 1982 (Note: this date has subsequently been changed to 16 September 1982).

An overview of the Buffalo Harbor study followed. Among the salient points were:

1. The study was authorized and funds appropriated for a 5 year $2,000,000 effort.

2. The purpose of the study is to look at the presently authorized federal project with a view toward determining the viability of improvements to the harbor area for commercial navigation purposes. Secondary purposes include drift and debris problems and recreational opportunities.

3. The Corps' planning process and how it is carried out with an emphasis on its relationship to the present study phase.

A question was raised as to the 19-year figure for a study to proceed from authorization to a completed project. Mr. Gilbert explained that due to the relatively short time between authorization and receipt of appropriated funds to begin work, the Buffalo Harbor study was ahead of this schedule. He indicated that it might take only 9 years after the study is complete for construction to begin.

Mr. Switala was then introduced and proceeded to detail how the actual study fits in with the general plan, as outlined by Mr. Gilbert, from the commercial navigation report and its executive summary to the supplementary report on revitalization efforts in the Buffalo Harbor area.

Stage 1, a preliminary overview, concluded that there were three areas of improvements that might be feasible: (1) River and Ship Canal improvements to accomodate 700-foot vessels; (2) transshipment options from the Outer Harbor to include such things as the use of conveyors and a slurry pipeline, and, (3) improvements centered around the South Entrance Channel only.

Stage 2, where we are now, analyzes more closely these alternatives from Stage 1, plus any new options that have arisen. Furthermore, it was

pointed out that even though certain recent events would appear to cast a pall over the study findings, since our outlook is spread over 50 years, the overall effect is lessened, with the Corps emphasizing a more positive future.

Mr. Switala then discussed the results of the Buffalo District user survey. The general and specific findings were:

GENERAL

1. Direct delivery is preferred.

2. A plan with the minimum amount of private investment is required.

3. There is interest in anything that will reduce transportation costs.

4. River realignment for existing vessels would certainly help.

5. There is a need for more operating draft in the River and Ship Canal.

SPECIFIC

1. Grain:
(a) the practicality of any type of transshipment system for grain was questioned due to problems with coordination of usage, distances involved and the need to separate types of grain.

2. Iron Ore:
(a) slurry pipeline is not practical.
(b) use of the Bethlehem Slip for transshipment is not feasible.
(c) rail and conveyor are two potentially feasible methods of transshipment.

3. Other Related Industries:
(a) NFTA land is available for a transshipment concept.
(b) it is possible that Independent Cement land would be made available for transshipment options.
(c) the maximum vessel size for River navigation is 639x72 feet.
(d) any cut through Kelly Island rail lines would require a new bridge.

Mr. Switala pointed out that these findings were used to do a preliminary screening of the feasible Stage 1 alternatives and to develop new alternatives for Stage 2 study.

The next part of Mr. Switala's presentation centered on the second and third iterations of the Outer Harbor screening process. These were based on a preliminary cost and benefit estimate computed for each alternative. A number of permutations were run on each of the plans in an effort to find

the most economically viable one. The resulting feasible plans are listed below:

DEEPENING

1. A limited deeping plan through the South Entrance Channel.

TRANSSHIPMENT

1. Rail and shuttle out of NFTA and permutations for grain.

2. Rail and shuttle out of Independent Cement and permutations for grain.

IMPROVEMENTS FOR THE SOUTH ENTRANCE CHANNEL

1. Improvements to the South Entrance Channel and a minimum amount of deepening in the Outer Harbor.

Before opening the meeting for discussion, Mr. Switala explained that the cost sharing rules for commercial navigation projects are now under review, which may result in greater non-federal costs. He went on to give some examples of how the cost for a particular project would be apportioned under existing rules and how they might be split under some of the proposed legislation.

A question and answer period followed. Among the topics discussed were:

1. The problem of the North Entrance Channel and "worst case" design criteria.

2. Effects of Great Lakes diversion on navigation.

3. Areas to be dredged.

4. Lightering from a 1000-foot vessel to vessels with a 19.5-foot draft for the up-river trip.

5. The feasibility of transshipment of limestone for steel mills.

6. Pipeline relocation costs.

7. Restriction of Ship Canal traffic due to grain conveyors.

8. Operating draft for ships: Corps' criteria vs. actual practices.

9. Channel deepening and bulkheading.

10. How grain benefits were derived.

11. Feasibility of a lock on the Buffalo River to control water depth.

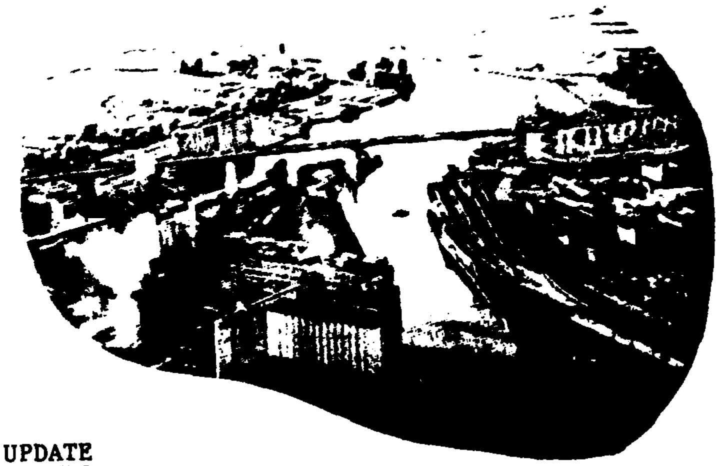
Mr. Gilbert closed the meeting by giving a synopsis and thanking everyone for their participation.

LIST OF ATTENDEES

Charles Gilbert, Corps of Engineers
Thomas Switala, Corps of Engineers
Bruce Sanders, Corps of Engineers
Ronald Guido, Corps of Engineers
Michael Pelone, Corps of Engineers
Roger Haberly, Corps of Engineers
Nora Mauck, Corps of Engineers
Henry Gartner, Corps of Engineers
Richard Gorecki, Corps of Engineers
James Conley, Corps of Engineers
James Kaloustian, Corps of Engineers
Robert Lannon, Republic Steel Corp. ✓
Denis Jackson, Peavey Company ✓
Victor Viglioli, Bethlehem Steel ✓
R. H. Limburg, American Malting, Inc. ✓
Jim Dessert, Founder's Supplies, Inc. ✓
K. O. Kauppi, International Multi-Foods, Inc.
Wally Gilbert, General Mills ✓
William Brehm, General Mills
R. B. Waters, Conrail
Sharon West, NFTA
Walter Headley, NFTA
Harry Byrd, Independent Cement Corp.
John Bunce, Independent Cement Corp.

Exhibit G-2

Buffalo Harbor Study



NEWS UPDATE

July 1982

During the course of the Buffalo Harbor Study, it is our intention to keep you advised of our progress on the study and notify you of any major developments. This news update deals specifically with the Drift and Debris Removal Study, which is a supplemental study that will appear as an appendix to the Buffalo Harbor Preliminary Feasibility Report. It should be emphasized at the outset that the drift and debris study is a supplementry effort to the Buffalo Harbor Study, and that it is being done to provide additional information on the study area.

The purpose of the Drift and Debris Removal Study is to determine the feasibility of establishing a Federal project for the collection, removal, and disposal of drift in Buffalo Harbor and the adjoining waterways. Attachment No. 1 illustrates the geographical area under consideration. The study will also investigate the feasibility of removing the sources of drift. The major sources of drift have been identified as tributary drift from the Buffalo River, waterfront structures such as abandoned buildings, docks, piles, piers, and loose onshore debris.

The problem with drift in the Buffalo Harbor is that it constitutes a menace to small boat navigation. Boat operators must exercise care in navigacing the waterways to avoid striking the drift. The greatest difficulty for small boat navigation is experienced at night or during fog conditions when the drift is difficult to see.

There were four alternative solutions identified in the early stages of the study. These four alternative solutions are presented below:

<u>Alternative I</u>. This is the no-action alternative. The base case against which all the other alternatives may be compared.

<u>Alternative II</u>. Establish a program for the continuous annual removal of drift in the harbor during the boating season.

U.S. ARMY ENGINEER DISTRICT, BUFFALO
1776 NIAGARA STREET
BUFFALO, N.Y., 14207

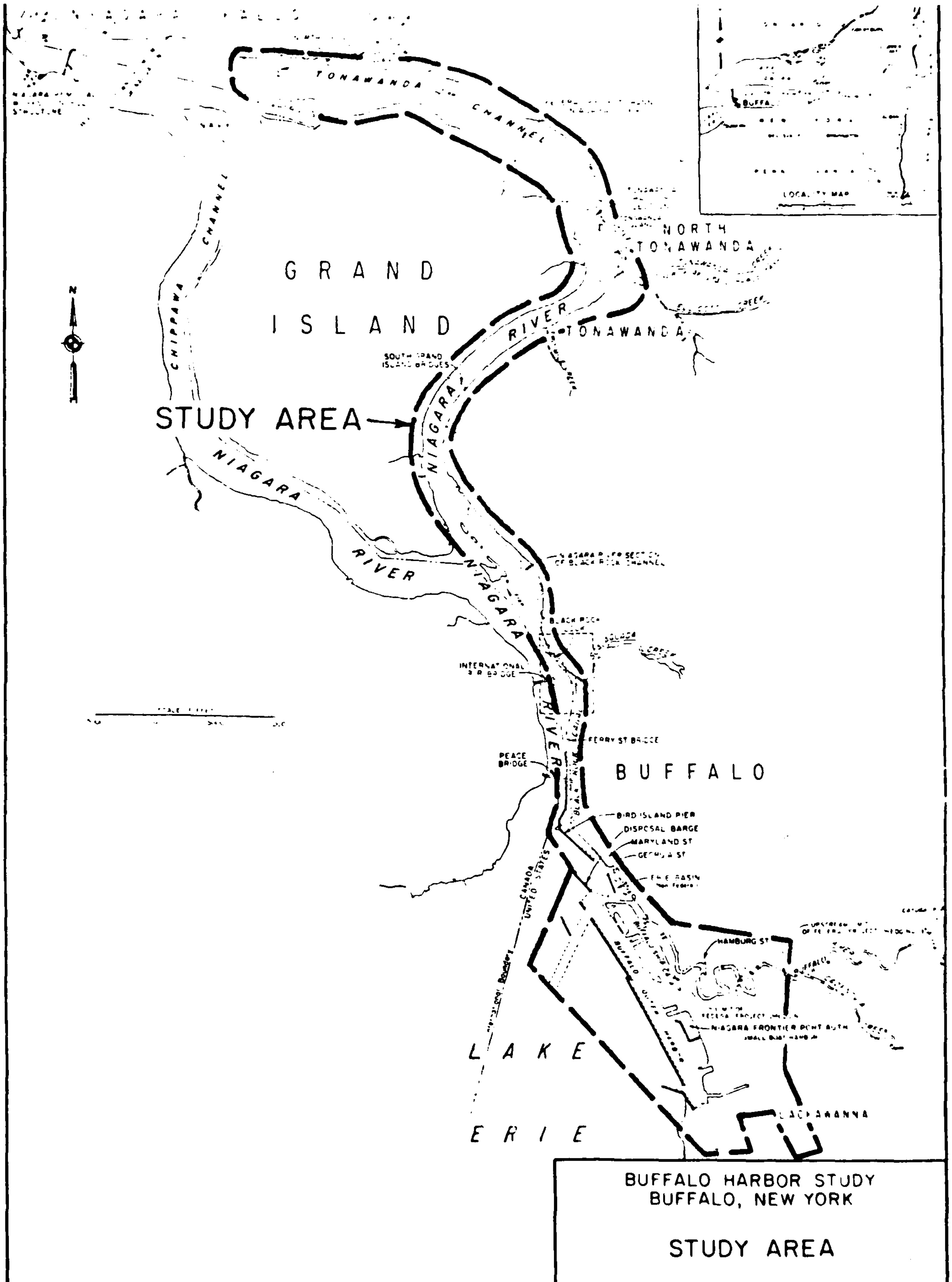
Exhibit G-3

Alternative III. Implement a one-time cleanup program to rid the harbor of the major structural sources of drift. These sources have been identified in field surveys and consist of dilapidated waterfront structures, loose onshore debris, sunken vessels, and tributary drift.

Alternative IV. Combine Alternatives II and III, for example, implement a one-time cleanup and then have a continuous annual program for the removal of drift as it enters the harbor.

The Drift and Debris Removal Study investigates the feasibility of each of these alternative solutions based on technical, economic, social, and environmental criteria. These solutions will be investigated in sufficient detail so that a determination can be made as to the feasibility of Federal participation in these solutions. This determination will be made and the results of the study published as an appendix to the Buffalo Harbor Preliminary Feasibility Report.

Please feel free to contact Tom Switala or Jim Conley at (716) 876-5454, with any questions you may have regarding the Supplemental Drift and Debris Study or the overall commercial navigation study.



Attachment 1

Interviews with Harbor Users
(January to May 1982)

During the plan formulation phase of Stage 2 study, personal interviews were conducted with most of the harbor users. The purposes of these meetings were to discuss various project alternatives and to obtain background information that would be used in the economic analysis. A listing of the companies contacted appears below.

Grain Mills

a. General Mills
b. Pillsbury
c. International Multifoods
d. American Malting
e. Peavey

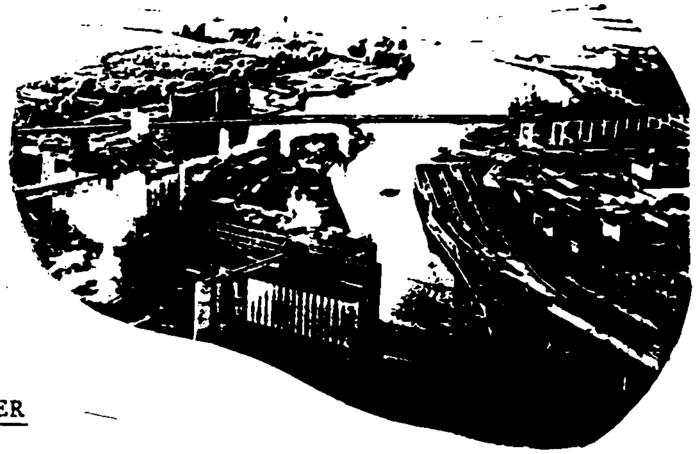
Steel Mills

a. Republic Steel
b. Hanna Furnace
c. Bethlehem Steel - telephone conversation only

Others

a. American Steamship Company
b. Port Authority of Buffalo (NFTA)
c. Conrail

Buffalo Harbor Study



NEWSLETTER

23 October 1981

What Has Happened!

The Buffalo District Corps of Engineers conducted a reconnaissance study of Buffalo Harbor between June 1980 and February 1981 to investigate the need for commercial navigation improvements that would support increased or changing commercial activities and attendant facilities, including prospects for bulk commodity transshipment facilities and modifications that would realign the Buffalo River. The study resulted in a 379-page report entitled, Reconnaissance Report, Buffalo Harbor, New York Feasibility Study, Final Report - April 1981, which was summarized into a 12-page pamphlet called simply Report Summary - April 1981. The Reconnaissance Report concluded that study should continue for three categories of harbor improvements:

a. Deepening of the Buffalo River and Ship Canal for vessels up to 700 feet in length,

b. Transshipment of bulk commodities from the outer harbor to upriver industrial facilities, and

c. Alteration of the south entrance of the outer harbor for safe all-weather, 1,000-foot vessel operation.

It also found that further investigation of realignment of the inner harbor (i.e. the Buffalo River and Ship Canal) for operation of 1,000-foot vessels is not warranted at this time.

While the reconnaissance effort was being completed, a supplementary study was initiated to meet the need for a thorough investigation of revitalization efforts and potentialities for the harbor areas. The purpose of this study was to present a set of revitalization alternatives for the harbor area that could be used by the Corps of Engineers as a backdrop against which commercial navigation alternatives can be more fully evaluated during Stages II and III of the planning effort for

U.S. ARMY ENGINEER DISTRICT, BUFFALO
1776 NIAGARA STREET
BUFFALO, N.Y., 14207

Buffalo Harbor. In addition, the study offered an opportunity for the Corps to identify specific recreation measures within its authority that can be carried forward in the planning process and eventually integrated with the commercial navigation alternatives identified in the reconnaissance study. The completion of the reconnaissance report marked the end of our Stage I planning effort as can be seen on the attached study flow network (see Incl 1). Stage II work commenced immediately with the awarding of a year-long biological sampling contract, completion of the revitalization report, formulation of plans for the installation of a wave gage, the refining of the course for Stage II study and the initiation of cultural resource studies. Additionally, a study concerning drift and debris problems in Buffalo Harbor and adjacent areas was initiated. This report will appear as an Appendix in our Stage II document.

What's to Come!!

Our Stage II Preliminary Feasibility Report is scheduled to be completed by December 1982. In contrast to the reconnaissance stage of planning (which concentrated on the identification of problems), Stage II planning emphasizes plan development and assessment. To further develop the plans, we will refine the preliminary alternatives developed during Stage I through collection of geotechnical data and utility information, and more detailed design work with refined cost estimates. To help us in plan development and assessments of impacts, additional data will be collected on cultural resources, social conditions, biological elements, and the economic climate of the area.

Finally we will seek out new solutions and analyze them as described above. Some of the work is already underway, the rest will be initiated soon.

One of the work items underway is the collection of data. We are sending letters to utility companies, agencies, and waterfront industries asking for data on the location of utilities, plans of waterfront structures, and subsurface information within the study area (see Incl 2). If you have any of these types of information and have not recently been contacted, please call Jim Karsten or Tom Switala at (716) 876-5454, ext. 2247.

How Can You Help?

We have worked closely with many of you in the past and we hope to continue this relationship to the end of our study. To insure the continuation of this effort, we are going to have a consultant organize and direct a formal public involvement program for the remainder of our Stage II study. Through this consultant we hope to keep you advised of our progress and ascertain your views.

You may also become involved by participating in the series of meetings that the city of Buffalo and the Corps of Engineers are cosponsoring regarding various aspects of the Buffalo waterfront. These meetings are designed to provide an open forum for discussion. They were initiated as a followup to the workshop that the Corps of Engineers held in January 1981 concerning waterfront redevelopment opportunities for Buffalo. A schedule of past and future followup meetings is listed below.

Corps of Engineers - City of Buffalo
Cosponsored Waterfront Development Meetings

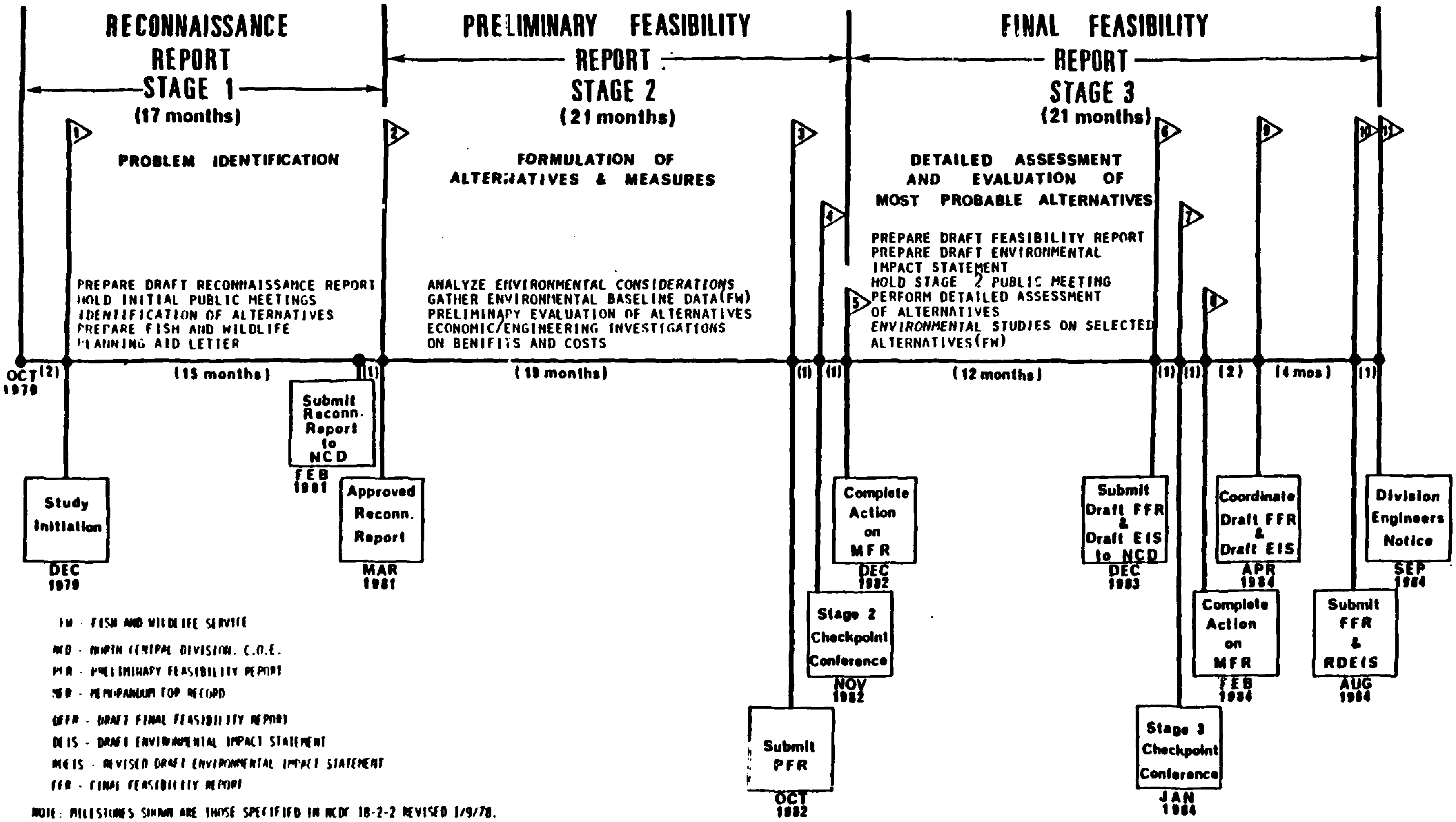
List of Followup Meetings

Past Meetings	Date Held
Debris Removal, Cleanup of Buffalo River	19 February 1981
Navigation and Harbor Improvements	19 February 1981
Trucking Facilities, Routes and Volumes	27 February 1981
Rationalizing Kelly Island Development and Transport	3 March 1981
Pollution in Buffalo River and Shoals	5 March 1981
Rail Facilities, Routes and Volumes	10 March 1981
Revitalization Study (Gulf South Research Inst.)	8 April 1981
Future Meetings*	**Future Dates**
Coastal Zone Management Program	December 1981
Impact on Buffalo of the Great Lakes System Improvement Studies	December 1981
Recreational Boating and Marina Development	Pending
Debris Removal and Cleanup Program for the Buffalo River and Harbor Area	Pending
Energy Development (coal, synthetic fuel, wind, etc.)	Pending

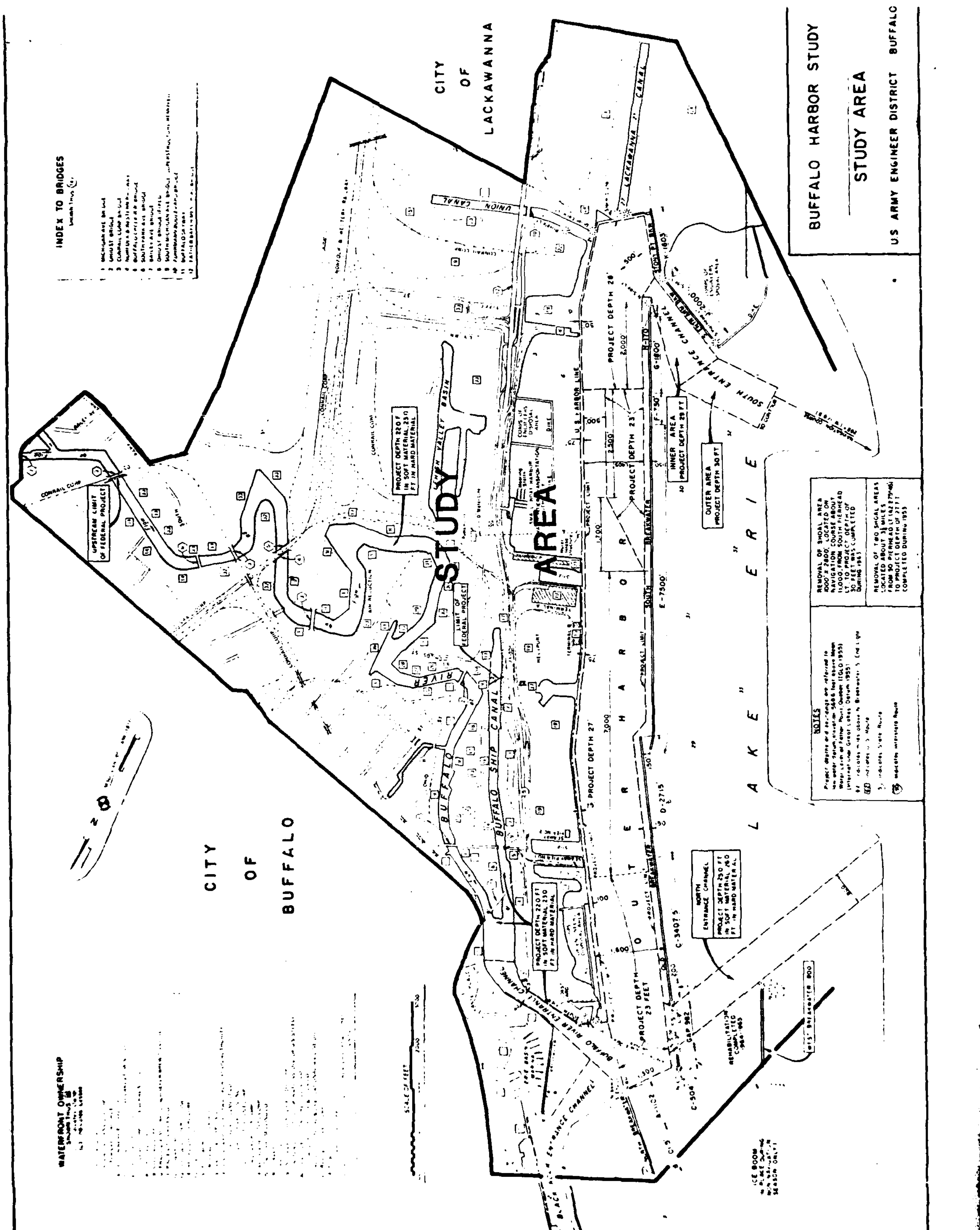
* Additional meetings may be added at a later date.

Finally, please feel free to contact Jim Karsten or Tom Switala at (716) 876-5454, extension 2247 with any questions you may have regarding the Buffalo Harbor Study. Additional information on the followup meetings can be obtained by contacting either Terry Martin of the city of Buffalo at (716) 855-5311 or Jim Karsten of the Corps of Engineers. Your input is important!

STUDY FLOW NETWORK (CPM) SHOWING MILESTONE EVENTS FOR BUFFALO HARBOR FEASIBILITY REPORT



Incl 1


BUFFALO HARBOR STUDY
STUDY AREA
U.S. ARMY ENGINEER DISTRICT BUFFALO
CITY OF LACKAWANNA
CITY OF BUFFALO
STUDY AREA
LAKE "ERIE"
OUTER HARBOR
INDEX TO BRIDGES
WATERFRONT OWNERSHIP
NOTES
UNION CANAL
LACKAWANNA CANAL
BUFFALO SHIP CANAL
BUFFALO RIVER
SOUTH ENTRANCE CHANNEL
BUFFALO RIVER ENTRANCE CHANNEL
BLACK ROCK ENTRANCE CHANNEL
U.S. HARBOR LINE
PROJECT DEPTH 28'
PROJECT DEPTH 23
PROJECT DEPTH 27
PROJECT DEPTH 23 FEET
INNER AREA PROJECT DEPTH 28 FT
OUTER AREA PROJECT DEPTH 30 FT
NORTH ENTRANCE CHANNEL PROJECT DEPTH 25.0 FT IN SOFT MATERIAL 26.0 FT IN HARD MATERIAL
UPSTREAM LIMIT OF FEDERAL PROJECT
LIMIT OF FEDERAL PROJECT
PROJECT DEPTH 22.0 FT IN SOFT MATERIAL 23.0 FT IN HARD MATERIAL
BREAKWATER
ICE BOOM
REHABILITATION COMPLETED

Incl 2

APPENDIX H
REPORTS OF OTHERS

BUFFALO HARBOR, NY

STAGE II
PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

APPENDIX H
REPORTS OF OTHERS

Exhibit	Description
H-1	U. S. Fish and Wildlife Service, 24 August 1982. Technical Assistance Letter.
H-2	New York State Department of Environmental Conservation, 19 August 1982. Comment on Stage 2 Alternatives.
H-3	Buffalo District Office of Counsel, 30 July 1982 memo regarding the legality of using Dike Disposal Area No. 4 for the disposal of dredged material from improvements recommended by the Buffalo Harbor Study.
H-4	U. S. Department of the Interior; National Park Service, 28 July 1982. Review of the Stage 2 draft assessment of cultural resources for both the Commercial Navigation Study and the Drift and Debris Study.
H-5	Buffalo District interoffice memo, 16 July 1982 regarding the estimated excess capacity of Dike No. 4.
H-6	Buffalo District interoffice memo, 13 July 1982 regarding the quality of sediments which would be dredged during improvements to the harbor.
H-7	New York State Office of Parks and Recreation; Historic Preservation Field Services, 25 June 1982 letter requesting comments on Stage 2 cultural resources assessment. No comments received.
H-8	New York State Museum and Science Service, 25 June 1982 letter requesting comments on Stage 2 cultural resources assessment. No comments recieved.
H-9	Buffalo District Trip Report, 1 October 1980 regarding the transit of a 1,000-foot vessel through the South Entrance Channel of Buffalo Harbor.
H-10	U. S. Fish and Wildlife Service, 4 September 1980 letter regarding threatened or endangered species.

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

August 24, 1982

Colonel Robert R. Hardiman
District Engineer, Buffalo District
U.S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hardiman:

This constitutes our technical assistance report which assesses impacts to fish and wildlife resources which could result from alternative plans developed for the Buffalo Harbor Commercial Navigation Study. Previous reports described fish and wildlife resources of the harbor area (July 2, 1980), and assessed impacts for an earlier set of alternatives (November 7, 1980). This does not constitute our report under the authority of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Our assessment is based on written descriptions of eight alternative plans provided with Mr. Bennett's letter of August 4, 1982.

Alternative Plan Descriptions

The eight alternatives present different combinations of measures which are designed to accomplish one or more of the following objectives:

1. To allow the grain industry to utilize the full draft of their vessels (Alternatives IId, IIe);

2. To allow the steel industry to utilize more of their available vessel draft (Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, and IVb); and

3. To eliminate some unsafe conditions at the South Entrance channel (Alternatives IIe, IIIf, IIIg, IIIh, IIIi, IVa, and IVb).

The principal measures of these plans are as follows:

1. Channel deepening (dredging), including the North and South Entrance Channels (29 to 32 feet), the Outer Harbor (27 to 30 feet), the Buffalo River and Ship Canal (25 feet), and the Lackawanna Canal (28 feet);

2. Removal of 750 feet of breakwater and construction of two new sections, 1,000 and 500 feet long, at the South Entrance; and

3. Replacement and new construction of steel sheet pile bulkhead along the Buffalo River and Ship Canal (7,000 feet), for bridge protection (960 feet), at the Allen Boat Company Slip (2,600 feet), and at the Independent Cement facility (2,800 feet).

Other measures included in the alternative plans are:

1. grain elevator demolition;

2. fenders to protect bridge piers in the Buffalo River and Ship Canal;

3. relocation of submerged utility lines;

4. construction of 2,000 to 8,400 feet of new railroad track and upgrading of existing tracks;

5. enlargement of the Allen Boat Company slip;

6. placement of about six acres of fill in a water area at the Independent Cement facility; and

7. grading of land for placement of iron ore. The measures associated with each alternative are shown in Figure 1.

Dredged spoil from channel deepening will be disposed in diked disposal area number 4 located at the South Entrance and adjacent to Bethlehem Steel. This is an existing, confined disposal site which receives material from annual maintenance dredging in Buffalo Harbor. It is possible that two of the eight alternative plans may produce dredged material in excess of the capacity of site number 4. If one of these plans is selected, and there is indeed excess material, a new disposal site would be located at that time.

Impact Analysis

The measures included with the various alternatives are discussed below.

Channel Deepening

The impact of large scale dredging at Buffalo Harbor on fish and wildlife resources would vary depending upon the location of the dredging.

Buffalo River, Ship Canal.

Dredging in these channels would cause a temporary increase in turbidity and suspended sediments. These sediments are grossly polluted by organic and toxic materials, which could also affect downstream waters including the Black Rock Canal and Niagara River.

Figure 1. Alternative measures, Buffalo Harbor Commercial Navigation Study

Measure	Alternative							
	IId	IIe	IIIf	IIIg	IIIh	IIIi	IVa	IVb
channel deepening								
entrance channels	+	+	+	+	+	+	+	+
Outer Harbor		+	+	+	+	+	+	+
Buffalo River, Ship Canal	+	+						
Lackawanna Canal		+	+	+	+	+	+	+
bulkhead replacement	+	+						
grain elevator demolition	+	+						
bridge pier protection (bulkhead, fender)	+	+						
utility relocation	+	+						
breakwater removal, construction		+	+	+	+	+	+	+
railroad construction, upgrading				+	+			
enlarge, bulkhead boat slip			+	+				
fill, bulkhead harbor area					+	+		
grade land for iron ore					+	+		
spoil disposal	+	+	+	+	+	+	+	+

The Buffalo River, Ship Canal, and downstream areas are already impacted by annual maintenance dredging, and the proposed work would represent only a change in the magnitude of such impacts. As documented in previous reports, as well as the recent Biological Survey (Makarewicz, et al. 1982), aquatic resource values are low in these waters, and the biota already adapted to extremes of water pollution, habitat degradation and frequent disturbance. Few impacts are therefore likely to occur to aquatic resources. The pollution tolerant benthic community of low diversity found there would be destroyed, but a new, probably more diverse community would eventually be established. Adult fish would likely be displaced from the dredging area.

Exposure to toxic suspended sediments could cause the bioaccumulation of some such materials in the aquatic ecosystem. The removal of large amounts of contaminated sediments, together with the general improvement in water quality in the watershed, should have a beneficial impact on aquatic resources in the Buffalo River over the long term.

Outer Harbor, Entrance Channels

The Outer Harbor supports a diverse and locally important fishery. Among the many, primarily warmwater species found there, rock bass, smallmouth bass, and yellow perch are abundant in the harbor during their expected spawning seasons (Makarewicz, et al. 1982). Dredging, however, would occur in the existing navigation channels which are deep and probably little used for spawning. These channels also are regularly maintenance dredged, and the biota in the vicinity should be adapted to this disturbance. Turbidity and suspended sediments would also be a problem in the Outer Harbor. Again, the existing benthic community would be destroyed, but another would reestablish itself. Adult fish would be temporarily displaced from the dredging area. If the dredging occurred during spawning in the Harbor, some disruption of spawning might occur. In addition, dredging during the principal fishing season would temporarily disrupt this recreational use of the harbor.

Lackawanna Canal

Although sediment data for this channel area are unavailable, impacts should be similar to the Buffalo River and Ship Canal. That is, a low quality aquatic resource which could only benefit from removal of contaminated materials.

Spoil Disposal

The continued use of diked disposal area number 4 is not expected to result in adverse impacts to fish and wildlife resources. Other disposal areas in the vicinity have become high value wildlife habitat after

completion of disposal. The ultimate fate of number 4 is unknown, however. If left in a natural condition, it too could provide significant wildlife and perhaps recreational values in an area where these values are in short supply.

If an additional disposal site is needed, further impact analysis will be required. We understand that four alternative disposal sites in the Buffalo Harbor area have been identified.

Bulkhead Replacement

A temporary increase in turbidity and suspended sediments would occur in the Buffalo River and Ship Canal during bulkhead construction. The bank material involved is thought to be mainly clean material. Since the new bulkhead would be replacing old, little change in fish and wildlife habitat would occur. The waters in this project are already turbid and frequently disturbed by maintenance dredging. Adult fish in the immediate vicinity would be displaced.

Grain Elevator Demolition

Impacts to fish and wildlife resources would be negligible.

Bridge Pier Protection

Minor amounts of turbidity and suspended sediments would temporarily result in the Buffalo River and Ship Canal. Impacts to fish and wildlife resources would be negligible.

Utility Relocation

Minor amounts of turbidity and suspended sediments would temporarily result in Buffalo Harbor waters during excavation and filling of submerged cables.

Breakwater Removal, Construction

This measure will result in the net loss of less than one acre of benthic habitat. The site is deep and relatively unproductive fish habitat, however (Makarewicz, et al. 1982). There will also be a net gain in breakwater habitat which may provide space for invertebrates or other aquatic biota.

Railroad Construction, Upgrading

According to project maps provided by the Corps of Engineers, new rail construction would take place alongside existing rails. Assuming this to be the case, impacts to fish and wildlife would be negligible.

AD-A129 189 BUFFALO HARBOR STUDY PRELIMINARY FEASIBILITY REPORT VOLUME II APPENDICES(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT APR 83 5/8

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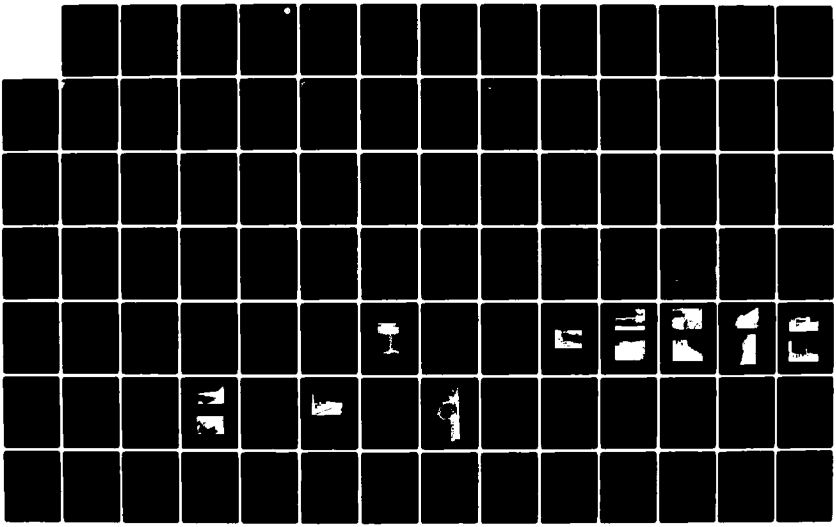

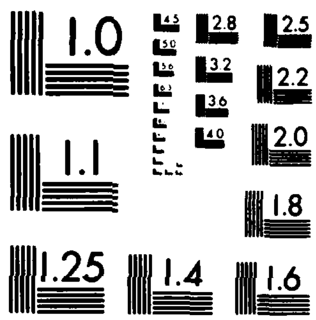

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A

Enlarge, Bulkhead Boat Slip

This measure would convert several acres of poor quality wildlife habitat into aquatic habitat of at least fair value. Temporary increases in turbidity and suspended sediments would result in a localized area within the Outer Harbor.

Fill, Bulkhead Harbor Area

About six acres of shallow water area would be filled adjacent to the Independent Cement Company. A small boat livery presently operates on this site. Although no biological data are available for this site, aerial photography indicates that it has probably been impacted by cement company operations, and is not productive aquatic habitat. Placement of fill should therefore not adversely impact fish and wildlife resources. If Alternative IIIh or IIIi is selected, this should be confirmed by field inspection.

Grade Land For Iron Ore

The land involved has been used for industrial purposes and has little wildlife value. Therefore, impacts to wildlife resources would be negligible.

The Fish and Wildlife Service does not anticipate objection to any of the alternative plans which we were provided. We would most likely recommend the following mitigation measures:

1. A date restriction on dredging in the Outer Harbor, to avoid the spawning season of the most important fish species;
2. close coordination in additional disposal site selection and planning, if needed; and
3. preparation of a plan for the ultimate use of the disposal site(s), emphasizing fish, wildlife, and recreational uses.

Thank you for the opportunity to participate in project planning. Please keep us informed of the progress of the study.

Sincerely yours,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

Literature Cited

Makarewicz, J.C., R.C. Dilcher, J.M. Haynes, and K. Shump. 1982. Biological Survey, Buffalo River and Outer Harbor of Buffalo, N.Y. Final Report. Brockport, NY. 102pp.

New York State Department of Environmental Conservation
Division of Regulatory Affairs-Region 9
600 Delaware Ave., Buffalo, NY 14202-1073
716/847-4551

Robert F. Flacke
Commissioner

August 19, 1982

Mr. James M. Bennett, Chief,
Environmental Resources Branch
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Re: Buffalo Harbor Commercial
Navigation Study Coordination

Dear Mr. Bennett:

Region 9 of the New York State Department of Environmental Conservation reviewed the work paper on alternate plan descriptions (with maps). The only comment we have for your consideration is the alternative of providing conveyor access in lieu of local rail services to Republic Steel and Hanna Furnace. This comment would, of course, be subject to your preliminary finding of economic feasibility.

We look forward to your further coordination and expect to have a greater input into those areas more closely corresponding to our expertise. Thank you.

Respectfully,

Steven J. Doleski

Steven J. Doleski
Regional Permit Administrator

PDE:ib

Exhibit N-2

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NCBOC	Use of Buffalo Disposal Area, Site 4, for disposal of dredged material from improvements recommended by the Buffalo Harbor Study.

THRU: District Counsel FROM Office of Counsel DATE 30 July 1982 CMT 1
Parson/jlw/2182

IN TURN: Chief, Planning Division CEG 8/4
Chief, Eastern District Basin JP 8/5

TO: Mr. Thomas C. Switala, Study Manager

1. This responds to your oral request for an opinion of the Office of Counsel on whether the Corps of Engineers Disposal Area in Buffalo Harbor, known as Site 4, can be used for the disposal of sediment generated by any improvements that would be recommended by the Buffalo Harbor Study.

2. Site 4 was constructed under authority of Section 123 of the River and Harbor Act of 1970, PL 91-611, which provided for the construction of contained spoil disposal facilities for polluted dredged spoil. Therefore, Site 4 can be used only for disposal of polluted spoil. Unpolluted material should be disposed of in accordance with Sections 9-8 and 11-7(a) of EP 1165-2-1.

3. Attached is guidance on this subject, received from NCD in 1977, which is still in effect. This guidance states that a Section 123 Disposal Area should not be used for new work, including increasing the project depth of an existing Federal navigation channel, unless specifically authorized by Congress.

4. In summary, Site 4 could be used for the disposal of polluted dredged material, generated from projects recommended by the Buffalo Harbor Study, if such use is specifically approved by Congress.

H. Frank Parson
H. FRANK PARSON
Assistant District Counsel

Incl
as

Exhibit H-3

DA FORM 1 FEB 62 2496 REPLACES DD FORM 96, WHICH IS OBSOLETE.

(Typed 4-8-77)

CHIN

Return to 7 RH

NCDPO

SUBJECT: Cost Sharing for Confined Spoil Disposal Facilities for Dredged Material

8 APR 1977

District Engineer, Detroit (NCEED-P)

A copy of our teletype, DTG 171500Z Feb 77, above subject and OCE's response is transmitted for your information.

FOR THE DIVISION ENGINEER:

2 Incl
as

BING C. CHIN
Chief, Program Development Office

CF: NCEED-PB
NCDPD-PF

JUDAK/6322/vkk

P 071500Z Feb 77

1 6 PP UU

DIVENGR NOCEN CHCO IL //NCDPO//

HQDA WASH DC //DAEN-CWB-C//

UNCLAS

SUBJECT: Cost Sharing for Confined Spoil Disposal Facilities for Dredged Material

1. References:

a. NCDPD-PF 1st indorsement, 21 January 1977, to NCEED-PB letter, 12 January 1977, subject: Applicability of Section 123 of PL 91-611 to New Work at Monroe Harbor, Michigan.

b. Sections 124 and 187 of the 1976 Water Resources Development Act.

c. DAEN-CWR letter, 19 Jan 1976, subject: Applicability of Section 123, Public Law 91-611 to New Work Spoil Disposal for Section 107 Study, Sterling State Park Harbor.

d. DAEN-CWP-C 2nd indorsement, 12 April 1976, to NCBED-DP letter, 13 August 1975, subject: Dunkirk Harbor, NY, Draft Phase I GDM - Allocation of Construction Costs Relatable to the Requirement for Confined Disposal of Polluted Dredged Material.

OC DE
PD
ED
CO

STEVE HUDAK, CE, NCDPO, [illegible]-353-6322
3 February 1977

OC ED XA
PD CO DD

HARLAN [illegible] JOHNSON
Colonel [illegible]

2

RECEIVED
FEB - 7 1977
NORTH CENTRAL DIV.
CHICAGO, ILL.

2 6 PP UU

DIVENGR NOCEN CHGO IL //NCDPO//

HQDA WASH DC //DAEN-CWB-C//

[illegible] DAEN-CWP-C and indorsement, 29 October 1975, to NCSED-DP letter, 30 July 1974, subject: Huron Harbor, Ohio, 1962 Project Modification - Phase I GDM.

f/ DAEN-CWE-B letter, 22 December 1975, subject: Huron Harbor, Ohio - Phase II - General Design Memorandum.

g. DAEN-CWB-C teletype, 261514Z Jan 77, subject: Disclosure of Fiscal Year 1978 Funding Capabilities and Budget Hearing Schedule.

2. We anticipate receiving several questions at the FY 1978 Appropriations Hearings that concern cost sharing policy for confined spoil disposal facilities for dredged material authorized by section 123 of PL 91-611. Our understanding of the guidance included in references 1a through 1d is that section 123 principles do not apply to new work unless specifically directed by Congress and consideration should be given to submitting a survey report recommending cost sharing similar to section 123 but not using section 123 authority. Several anticipated questions and proposed answers on this subject

STEVE HUDAK, CE, NCDPO 353-6322
3 February 1977

3

3 6 PP UU

DIVENGR NOCEN CHGO IL //NCDPO//

HQDA WASH DC //DAEN-CWB-C//

related to preauthorization studies are listed below. We request your concurrence with the answers or specific guidance which modifies them before the Appropriations Hearings in accordance with paragraph 6 of reference 1g.

a. Question: Will the Corps of Engineers pay the cost of confinement of polluted new work dredged material under Section 123?

Answer: Under Section 123, the Corps can only pay for the confinement of maintenance dredging. This authority cannot be extended to the confinement of new work dredged material unless specifically authorized.

b. Question: Are local interests then required to pay for the confinement of new work dredged material?

Answer: We are handling this on a case by case basis. By this I mean we are placing a statement in the recommendations section of specific project studies that Congress authorize the Corps to pay the cost of the confinement dikes at the project being authorized. That is, the Corps will pay 75% of the cost or 100% if local interests

~~[illegible] waiver from~~

STEVE HUDAK, CE, NCDPO, 353-6322
3 February 1977

obtain a waiver from EPA.

c. Question: Then, you are telling me the Corps has no umbrella authority to pay the cost of confined spoil disposal facilities for new work dredged material.

Answer: That is correct. Section 123 is interpreted to apply only to the confinement of polluted maintenance dredging. There presently is no law that pertains to the confinement of new work dredging.

3. A different situation exists with regard to confinement of dredged materials at the Huron Harbor, OH project modification authorized by the 1962 River and Harbor Act as recommended in HD 165/87/1. When the survey report was prepared in 1959, it was assumed that the dredged material would be deposited in an established dump ground in Lake Erie and provision of a confined spoil disposal facility was not contemplated. In view of this assumption, the items of local cooperation did not include provision of a

STEVE HUDAK, CE, NCDPO 353-6322
3 February 1977

5 6 PP UU

DIVENGR NOCEN CHGO IL //NCDPO//

HQDA WASH DC //DAEN-CWB-C//

confined spoil disposal facility by non-Federal interests. After enactment of PL 91-611 in 1970, studies of maintanance dredging at Huron Harbor indicated that the dredged material is polluted and is unsuitable for disposal in Lake Erie. In accordance with Section 123, a confined spoil disposal facility was constructed at Huron Harbor with sufficient volume to also contain polluted material dredged during harbor deepening. Additionally, the Phase I and Phase II GDM's for the 1962 modification included the cost of depositing the dredged material as a Federal expense due to the absence of any item of local cooperation that required non-Federal interests to provide confined spoil disposal facilities. OCE comments on these GDM's in references 1e and 1f did not dispute this procedure. Due to these circumstances, it appears that Huron Harbor is a special situation that is not precedent setting because the project was authorized in 1962, 8 years before enactment of PL 91-611, and the items of local cooperation did not address provision

STEVE HUDAK, CE, NCDPO 353-6322
3 February 1977

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DIVENGR NOCEN CHGO IL //NCDPO//

HQDA WASH DC //DAEN-CWB-C//

of a confined spoil disposal facility. We also request concurrence with this viewpoint or specific guidance concerning the relationship of the Huron Harbor, OH situation with references 1a through 1d.

STEVE HUDAK, CE, NCDPO 353-6322
3 February 1977

7

JPB 20 Jan ..
BEIRS/05466/ca/JAN 20

NCDPD-PF (12 Jan 77) 1st Ind
SUBJECT: Applicability of Section 123 of P.L. 91-611 to New Work at Monroe Harbor, Michigan

DA, North Central Div., Corps of Engineers, 536 S. Clark St., Chicago, Ill. 60605

21 JAN 1977

TO: HQDA (DAEN-CWP-C), WASH D.C. 20314

1. Based upon recent OCE guidance we intend to pursue the matter of cost-sharing for dredged spoil disposal as outlined in the basic.

2. Please reconfirm your previous guidance and furnish any further insights you may have in this regard.

FOR THE DIVISION ENGINEER:

EDWIN V. WEISS
Chief, Planning Division

Copy furnished:
Detroit District

8

DETROIT DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1027
DETROIT, MICHIGAN 48231

12 JAN 1977

NCEED-PB

SUBJECT: Applicability of Section 123 of P.L. 91-611 to New Work at Monroe Harbor, Michigan

Division Engineer, North Central
ATTN: NCDPD-PF

1. Reference: DAEN-CWR letter dated 19 January 1976, subject, Applicability of Section 123, Public Law 91-611 to New Work Spoil Disposal for Section 107 Study, Sterling State Park Harbor.

2. One of the alternatives being considered in the Monroe Harbor Feasibility Study is an increase in the project depth of the existing Federal navigation channel from 21 feet to 27 feet. This alternative involves the disposal of a large quantity of dredged material which at present is classified as polluted.

3. Paragraph 2 of reference letter states that application of Section 123 of P.L. 91-611 to new work dredging may be justified, but does not appear appropriate unless so authorized by Congress. Paragraph 3 of reference letter implies that we should submit the report recommending application of Section 123 thereby allowing Congress to authorize the application.

4. In the absence of any further policy guidance, we intend to proceed with the question of new work dredging spoil disposal at Monroe Harbor on the basis that Section 123 of Public Law 91-611 would apply to this project. Your concurrence on this action is requested.

FOR THE DISTRICT ENGINEER

B. MALAMUD
Acting Chief, Engineering Division

expansion of both ports. Such testing shall include, but not be limited to, investigation of oscillations, tidal flushing characteristics, water quality, improvements for navigation, dredging, harbor fills, and physical structures.

SEC. 124. (a) The Corpus Christi ship canal project for navigation in Corpus Christi Bay, Texas, authorized by the Rivers and Harbors Act of 1968 (P.L. 90–483) is hereby modified to provide that the non-Federal interests shall contribute 25 per centum of the costs of areas required for initial and subsequent disposal of spoil, and of necessary retaining dikes, bulkheads, and embankments therefor. Credit shall be allowed in connection with the above project in an amount equal to the reasonable expenditures made by non-Federal interests in the acquisition of spoil areas and construction of necessary retaining dikes, bulkheads, and embankments prior to the effective date of the Water Resources Development Act of 1976.

(b) The requirements for appropriate non-Federal interests to contribute 25 per centum of the construction costs as set forth in subsection (a) shall be waived by the Secretary of the Army upon a finding by the Administrator of the Environmental Protection Agency that for the area to which such construction applies, the State of Texas, interstate agency, municipality, and other appropriate political subdivisions of the State and industrial concerns are participating in and in compliance with an approved plan for the general geographical area of the dredging activity for construction, modification, expansion, or rehabilitation of waste treatment facilities and the Administrator has found that applicable water quality standards are not being violated.

SEC. 125. For purposes of section 9 of the Act of March 3, 1899 (30 Stat. 1151; 33 U.S.C. 401), the consent of Congress is hereby given to the State of Louisiana to construct such structures across any navigable water of the United States as may be necessary for the construction of the following highways:

(1) Ivanhoe-Jeanerette, State project numbered 431–01–01 and 431–01–02 in Iberia and Saint Mary Parishes, Louisiana;

(2) Larose-Lafitte Highway, State Route La 3134 in Jefferson and Lafourche Parishes, Louisiana, starting at Estelle in Jefferson Parish and proceeding southwesterly to Larose in Lafourche Parish; and

(3) United States 90 Relocated (La 3052), in Saint Mary, Assumption, Terrebonne, and Lafourche Parishes, Louisiana, starting at United States 90 west of Raceland and proceeding westerly to a connection with United States 90 at or near Morgan City, Louisiana.

SEC. 126. The Secretary of the Army, acting through the Chief of Engineers, is authorized to undertake the phase I design memorandum stage of advanced engineering and design of a project for flood prevention and development of incidental recreation, preservation of the natural floodways, and protection of the watershed's soil resources, at an estimated cost of $570,000, substantially in accordance with the Floodwater Management Plan, North Branch of the Chicago River Watershed, Cook and Lake Counties, Illinois, dated October 1974, and also substantially in accordance with the watershed implementation program dated February 1974.

of local cooperation shall not apply to the construction of bridges (at a cost not to exceed $71,500,000) required as a result of the construction of the Mississippi River-Gulf outlet channel if the Secretary of the Army, after consultation with the Secretary of Transportation, determines prior to the construction of such bridges that the Federal Government will not assume the costs of such work in accordance with section 132(c) of the Federal-Aid Highway Act of 1976 (Public Law 94-280); and before construction of the bridges may be initiated the non-Federal public bodies involved shall agree pursuant to section 221 of the Flood Control Act of 1970 (Public Law 91-611) to (a) hold and save the United States free from damages resulting from construction of the bridges and their approaches, (b) provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the bridges and their approaches, and (c) maintain and operate the bridges and their approaches after construction is completed".

SEC. 187. The project for navigation and bank stabilization in the Red River Waterway, Louisiana, Texas, Arkansas, and Oklahoma, authorized by the Rivers and Harbors Act of 1968 (82 Stat. 731) is hereby modified to provide that the non-Federal interests shall contribute 25 per centum of the construction costs of retaining dikes, bulkheads, and embankments required for initial and subsequent disposal of dredged material, and the Federal cost shall be 75 per centum (currently estimated at $3,700,000). The requirements for appropriate non-Federal interests to furnish an agreement to contribute 25 per centum of the construction cost set forth above shall be waived by the Secretary of the Army upon a finding by the Administrator of the Environmental Protection Agency that for the area to which such construction applies, the State or States involved, interstate agency, municipality, other appropriate political subdivisions of the State, and industrial concerns are participating in and in compliance with an approved plan for the general geographical area of the dredging activity for construction, modification, expansion, or rehabilitation of waste treatment facilities and the Administrator has found that applicable water quality standards are not being violated.

SEC. 188. Notwithstanding any other provision of law, the Secretary of the Army, acting through the Chief of Engineers, at the request of the city of Williston, North Dakota, is authorized and directed to take such action as may be necessary to relocate certain water intakes, located on a pier of the Lewis and Clark Bridge on the Missouri River, threatened by siltation. There is authorized to be appropriated not to exceed $1,000,000 to carry out the provisions of this section.

SEC. 189. (a) The project for Tuttle Creek Lake, Big Blue Lake, Kansas, authorized as a unit of the comprehensive plan for flood control and other purposes, Missouri River Basin, by the Flood Control Act approved June 28, 1938, as modified, is hereby further modified to authorize and direct the Secretary of the Army, acting through the Chief of Engineers, to (1) provide a residential access road near Waterville, Kansas, from a point of intersection with FAS Route 431, located approximately 0.2 miles south of the northeast corner of section 16, township 4 south, range 6 east, and extending in an east southeasterly direction to a point of intersection with the existing

CLC - 7.c
FJK
MK - Dike Engineer - Stability

DAEN-CWP-C (13 Aug 75) 2nd Ind
SUBJECT: Dunkirk Harbor, NY, Draft Phase I GDM - Allocation of Construction Costs Relatable to the Requirement for Confined Disposal of Polluted Dredged Material

12 APR 1976

DA, Office of the Chief of Engineers, Washington, DC 20314

TO: Division Engineer, North Central

1. Reference is made to DAEN-CWR letter 19 Jan 1976, subject: Applicability of Section 123, Public Law 91-611 to New Work Spoil Disposal for Section 107 Study, Sterling State Park Harbor.

2. The basic rationale expressed in the referenced letter, that Section 123 principles do not apply to new work unless specifically directed by Congress, would also apply to this case. The projects addressed in Counsel's memorandum of 21 Sep 71 were projects in operation and maintenance status. [The small boat harbor was authorized in 1971, after enactment of Public Law 91-611.]

3. You should report spoil disposal as being cost-shared in accordance with established policy for projects of this type. The District's economic analysis should include all costs, including dike costs and transportation costs for moving dredged material. Spoil transportation costs, whether by pipeline, hopper dredge, or other means, are considered a dredging cost.

FOR THE CHIEF OF ENGINEERS:

1 Incl
nc

for Maurice W. Reeve, Col CE
ERNEST GRAVES
Major General, USA
Director of Civil Works

CF:
District Engineer, Chicago
District Engineer, Detroit
District Engineer, Buffalo
District Engineer, St. Paul

GLC

19 JAN 1976

DAEN-CWR

SUBJECT: Applicability of Section 123, Public Law 91-611 to New Work Spoil Disposal for Section 107 Study, Sterling State Park Harbor

Division Engineer, North Central

1. Reference NCD 25 Sep 75 and 30 Dec 75 teletypes, same subject. Upon further consideration, we do not view the provisions of Section 123, P. L. 91-611, as being properly applicable to the proposed Section 107 project.

2. The Great Lakes diked disposal program was proposed to Congress in terms of meeting maintenance dredging requirements at existing harbors, with no explicit provision for new projects. While application of Sec. 123 to new work at existing harbors might be justified, application to new projects does not appear appropriate unless so authorized by Congress. Provisions of paragraph 1-53a(1) of EM 1120-2-101 will apply if Sec. 107 authority is used.

3. You should consider submitting a survey report recommending application of Sec. 123, as was done in the case of March 1974 Review Report on Milwaukee Harbor, Wisconsin.

FOR THE CHIEF OF ENGINEERS:

ERNEST GRAVES
Major General, USA
Director of Civil Works

Application of Diked Disposal Facility Program (Sec. 123 of P.L. 91-611, the 1970 R&H Act) to Small Navigation Projects in the Great Lakes

1. Issues:

a. Should Sec. 123 cost sharing be applied to disposal of dredged material on projects authorized after 1970 without getting specific authority from Congress?

b. Should Sec. 123 cost sharing be applied to diked disposal facilities apart from the $1 million limitation on the Federal share specified in Sec. 107?

These issues have surfaced in the current survey of a potential recreational boat harbor at Sterling State Park (Michigan) conducted under Sec. 107.

2. Background:

a. The Corps Great Lakes diked disposal program that was recommended to Congress in 1970 was formulated for maintenance dredging requirements on existing O&M projects only. Potential new work requirements were not considered, apparently because we were preoccupied with the immediate problem on existing O&M projects and because we believed that undisturbed sediments from any new work would be suitable for open water disposal.

b. The language of Sec. 123 makes no distinction between new work and O&M: it simply authorizes facilities wherever necessary and whenever certain specific conditions are met. The Act does not tie diked disposal facilities with specific projects nor does the Act or its legislative history give any clue as to what projects, if any, besides O&M projects were intended to be covered. House PW&T Committee staff have expressed their view, however, that the program was intended to meet the then-existing polluted material disposal problem, and not to meet problems associated with new projects. The legislative history of the Act in the House Committee report is clear, however, that it was intended to amend or supersede any previous provision of law or contract. We have taken this expression of intent to mean that Sec. 123 applies to new work, as well as O&M, on all projects authorized in 1970 or before. We would also take it to mean that provisions of general legislation, such as Sec. 107 of the 1962 R&H Act, are modified by Sec. 123.

c. OCE first addressed the issue of applying Sec. 123 to new projects in 1972 in connection with the Milwaukee Harbor Extension survey reports. Disagreement within OCE was resolved by allowing the District Engineer to recommend cost sharing for the diked disposal facility on the basis of Sec. 123 (instead of following the standard disposal area recommendation language), but the additional facility costs were to be included as project costs in the benefit-cost analysis. BERH did not act on the report, for other reasons, so the Sec. 123 issue did not receive Administration review or Congressional action. No other routine opportunity to obtain a decision on the coverage of Sec. 123 has arisen.

d. In carrying out the various small project authorities, the Corps has traditionally taken the position that it would administratively authorize projects only under provisions consistent with those applying to similar projects authorized by Congress. We have no established predecent to follow in setting requirements for navigation project disposal areas except the standard conditions of local participation.

e. Finally, the Great Lakes diked disposal program has come under increasingly critical scrutiny by OMB. This suggests that action to expand the program by internal administrative decision should be examined carefully.

3. Case Involved: A highly desirable recreational boat harbor development is being considered by NCD of Sterling State Park, Michigan, under Sec. 107 authority. Costs of the harbor facility itself now exceeds \$2 million; so under 50-50 cost sharing, the Federal limitation of \$1 million means that all additional costs will be non-Federal. Diked disposal facilities are required. If their costs are considered project costs, local interests will have to bear them. If Sec. 123 applies separately, the local share will consist of land costs plus zero or 25 percent of construction costs, depending on circumstances. NCD needs guidance to inform local interests of their probable cost burden.

4. Alternative Positions:

a. Regard Sec. 123 as applying to projects authorized after 1970, as well as to those projects authorized before that time. If we take this position, the Sterling State Park project could be regarded as separate from the diked disposal facility, for cost sharing purposes. Given the uncertainty of policy in this area, this would be a fairly significant policy decision for the Corps to take on its own.

b. Regard Sec. 123 as not applying to projects authorized after 1970 until a precedent is set by Congress on a new project. This would be a conservative approach. In the case of the Sterling State Park project, it would mean requiring local assumption of whatever diked

disposal facility costs are required if the small project authority is used. Local interests are unwilling to do this.

c. Convert the Sec. 107 study into a regular survey report recommending Sec. 123 cost sharing for the diked disposal facilities and process for decision.

United States Department of the Interior

NATIONAL PARK SERVICE

MID-ATLANTIC REGION
143 SOUTH THIRD STREET
PHILADELPHIA, PA 19106

IN REPLY REFER TO

[illegible] 1982

Mr. Charles E. Gilbert
Chief, Planning Division
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Gilbert:

In response to your request of 25 June 1982, my staff archeologist, Mr. Chapman, has reviewed the draft report entitled Cultural Resources Preliminary Assessment for the Buffalo Harbor Commercial Navigation and Debris Removal Studies.

The report is a very good preliminary assessment document. It is apparent that a great deal of effort was spent researching the cultural development of this important area. The research is well documented and the conclusions and recommendations are appropriate in most cases. Your staff is to be complemented for having produced a concise, readable assessment. Several items which warrant comment are addressed in the following paragraphs.

On page 1 in the Methodology Section, the list of primary sources does not contain references to either the State Historic Preservation Officer or the New York State Museum. Both of these have site files which in many cases do not duplicate each other or those available at the regional level. This is especially true of the results of small surveys which may have been performed for compliance. In the third paragraph on Page 10, there is mention of the Hopewell "phase"; in this case it should be plural as there are a number of Hopewell phases in Ohio and other states. This also gets around the question of what exactly Hopewell should be called; a culture, a tradition, a horizon, etc.

The most serious comment involves the definition of low sensitivity areas on Page 20. An area cannot be designated as low sensitivity due to little or no data to judge its potential. The report should address more explicitly the types of locations which are not likely to contain sites. The past environment of the area must be used to make this determination. At present, it may be more appropriate to define areas of "unknown" sensitivity rather than low sensitivity. At the bottom of page 62 and continuing to page 63, there is a reference to the Historic Civil Engineering Landmarks. Should this be the Historic American Engineering Record?

Year of the Visitor

Exhibit H-4

We hope that these comments will be useful to your staff in considering the cultural resources of this area. Thank you for the opportunity to review this report.

Sincerely,

Myra F. Harrison

Myra F. Harrison
Assistant Regional Director
Office of Cultural Programs

cc: New York SHPO

Buffalo Dike Disposal Facility Capacity

The purpose of this information is to provide planning with the estimated capacity in Dike 4, Buffalo, NY, for their GI Studies.

1. Design Capacity - Reference "Design Analysis, Disposal Area Development for Harbor Dredgings, Buffalo, NY," October 1973, by Dehea Cather and Company, (pg 39-42, Part II).

The design capacity is based on:

a. Cross sections taken at 100-foot intervals to existing south entrance arm.

b. Expected dredged material to be placed to elevation 580.6 IGLD (+12.0 LWD).

c. The top of the dike required a 2-foot freeboard (+14.0 LWD).

The volume of the area contained by the dike was calculated to be 5,598,702.0 cubic yards and rounded off to 5.6 million cubic yards.

A 20 percent consolidation factor was used to calculate the total quantity of in situ dredgings that could be placed into the dike. That quantity was rounded off at 6.9 million cubic yards.

2. The dike disposal facility was completed in April 1978 by the "Firelands Sewer and Water" at a cost of $16.8 million ($2.45/estimated cubic yard of disposal space). Current estimated cost for permittee disposal (DF DTD 2 Feb 79) is $2.45/cubic yard place measure.

a. Disposal in Dike 4 commenced in August 1977 under a dredging contract to Great Lakes and Dock Company.

The disposal in Dike 4 since its construction is:

Year	Date	Sediment Location	Cubic Yard Quantity (2)	Contractor
77	17 Aug 77-14 Nov 77	Buffalo River	309,847	Great Lakes
	17 Aug 77-14 Nov 77	Buffalo Harbor	701,495	Great Lakes
78	26 Sep 78-7 Oct 78	Black Rock Channel and Tonawanda Harbor	11,601	Hoffman
	4 Oct 78-21 Dec 78	Buffalo Harbor	240,461	Hoffman
79	21 Aug 79-22 Sep 79	Black Rock Lock and Tonawanda Harbor	26,503	Hoffman
	21 Aug 79-17 Sep 79	Buffalo Harbor	91,553	Hoffman
	17 Sep 79-30 Sep 79	Buffalo Harbor	23,662	Hoffman
	5 Oct 79-13 Nov 79	Buffalo Harbor	5,207	Hoffman
	20-21 Oct 79	Black Rock Lock and Tonawanda Harbor	600	Hoffman
80	20 Aug 80-3 Oct 80	Buffalo River	134,618	Hoffman
	22 Aug 80-18 Nov 80	Buffalo Harbor	143,918	Hoffman
81	19 Aug 81-22 Nov 81	Buffalo River	141,780 (1)	Hoffman
	22 Sep 81-25 Nov 81	Buffalo Harbor	71,111 (1)	Hoffman
	Total		1,402,356	
	Average/Year Since 1977		280,471	

(1) Data from "Calendar Year Summary of Dredging" (reference Attachment 1).

(2) Data from NCBCO-MO letter dated 19 February 1982 to Mr. Saulys (reference Attachment 2).

Average (Mean) Annual Dredging (1) based on 10 years of records	Buffalo Harbor	- 149,512
	Buffalo River	- 135,831
	BRL and Tonawanda Harbor	- 14,718
		300,061

3. The Disposal Facility was designed to contain 690,000 cubic yards of dredged material per year for 10 years.

1. Design Capacity	6.900,000 cubic yard
2. a. Disposal to Date (5 years) for Navigation	1,402,356 cubic yard
b. Disposal to Date (5 years) for Permittee	116,783 cubic yard
3. Remaining Capacity in Disposal Facility (1 minus 2)	5,380,861 cubic yard
4. Volume of Material Required to be Placed in Dike Under PL 91-611, FY 82-FY 86	
300,000 cy/yr HBR X 5 yr (Corps)	1,500,000
30,000 cy/yr X 5 yr (Permittee)	150,000
5. Remaining Capacity in Dike 4 for Disposal (1 minus (2+4))	3,730,861

4. <u>Summary</u> - The dike was designed to contain 690,000 cubic yards of material per year for 10 years. The first 5 years of filling have been complete with an average of approximately 300,000 cubic yards of material being disposed of in the dike per year. Thus, 390,000 cubic yards X 5 years = 1,950,000 cubic yards of capacity has not been utilized to date with the total unused capacity at the end of 10 years presently anticipated to be approximately 3.7 million cubic yards.

Calendar Year Summary of Dredging

	MEAN (Annual)	81	80	79	78	77	76	75	74	73	72	71	[illegible]
Ashtabula	195,667	—	183,335	100,038	49,643	120,816	114,081	324,292	834,110	371,144	-	107,584	142,9[illegible]
BRC & TH	14,718	—	—	37,085	13,061			1,432		27,554	23,842	54,120	19,52[illegible]
Buffalo Harbor	149,512	141,780	154,965	147,522	107,194	201,492	3,849		30,676	172,531	31,806	321,691	480,633
River *	135,831	71,111	134,588	113,400	106,283	309,837	205,525	263,248	137,221	124,361	164,400		
Cleveland Harbor	168,670	35,355	43,064	147,728	165,987	92,710	65,185	74,922		88,388	193,552	177,942	104,2[illegible]
River	388,655				512,993	607,923	711,335	398,394	513,163	389,240	566,639	556,851	407,31[illegible]
Conneaut	138,660	—	114,891	56,940	28,715	114,440	61,244	574,810	249,444	98,152	92,154	161,504	111,629
Dunkirk	6,827	—	—					18,765	37,117				26,04[illegible]
Erie	168,441	49,768	972	41,814		197,837	388,076	255,391	325,464	203,440	168,660	207,656	182,219
Fairport	262,980	64,316	9,649	43,655	264,096	131,828	279,638	313,240	900,669	248,106	196,040	268,283	436,24[illegible]
Great Sodus	1,553	—	—	←	none		→	18,631					
Huron	140,530	—	408,880		NW	NW	114,081	143,679	255,455	293,872	198,931	129,838	141,62[illegible]
Little Sodus	8,669	—	—	←		none	→	2,318	19,155		22,187	24,914	35,457
Lorain	140,027	132,844	96,194	192,047		30,420	42,290	134,986	498,586	83,922	143,598	136,021	189,41[illegible]
Oswego	78,467	—	—	43,710		118,632	54,411	159,170	100,286	132,801	127,909	204,686	
Rochester	283,110	135,427	188,436	278,828	364,577	163,096	372,021	243,479	662,211	66,914	312,455	302,923	306,95[illegible]
Rocky River	3,671	—	—				44,050						
Sandusky	295,496	—	127,605	277,544		143,344	187,845	630,398	163,151	821,936	449,487	219,501	325,136
Toledo	508,944	1,342,513	1,283,145	1,119,224	1,425,202	937,159							
Vermilion	3,891	—	—	32,315 (misc)	3,760			10,723**					

** Credited (pay place) includes 2170 TONAWANDA & 4880 Hauled.

HAUL - ALL MATERIALS EXCAVATED DOES NOT INCLUDE OVERDEPTH (SOMETIMES EXCEED PLAN

PLACE - BEFORE + AFTER SOUNDING

ATTCH 1.

ra/2282

NCBCO-HO

19 February 1982

Mr. Vacys J. Saulys
Chief, Remedial Programs Staff
US-EPA
Great Lakes National Program Office
536 South Clark Street
Chicago, IL 60605

Dear Mr. Saulys:

This is in response to your letter dated 5 February 1982 requesting information about Federal dredging, disposal and fill activities in the Buffalo/Niagara River area.

Enclosed is a chronological inventory of dredging activities from 1960 to present. The information for 1960 through 1964 is taken from the Annual Report of the Chief of Engineers on Civil Works Activities. This is the most detailed information we have for these years.

The information for 1965 to present in taken from the Hopper Dredges' Report of Operations.

At this time we have not verified the exact disposal sites for the period of 1960-1974. Should this information be imparative, please contact me.

Also enclosed is a map showing the Buffalo disposal areas.

Should you require additional assistance, please feel free to call on me.

Sincerely,

DONALD E. BORKOWSKI, Acting Chief
Maintenance and Operations Branch

Incl
as stated

Rowen

Borkowski

ATTCH 2

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGO.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NCBED-HQ	Buffalo Harbor Sediments

TO : T. Switala   FROM : R. Leonard   DATE 13 July 1982   CMT 1
RL/2270

1. This d.f. constitutes a preliminary assessment of the quality of sediments (and rock) which would be dredged from the Buffalo Harbor and River for the Buffalo Harbor Improvement Study Stage II Document, and the disposition of these materials.

2. Surface sediments from the Buffalo Harbor and River were sampled in 1981. Based on analytical results and using EPA criteria, both areas would be classified as moderately to heavily polluted. Therefore, continued disposal of normal maintenance dredging material in diked disposal area #4 has been recommended. It must be cautioned however that the samples were taken from the surface to perhaps six inches depth and may not represent the quality of materials at deeper depths. Channel depths may be increased from 1 foot to 5 feet under the navigation improvement alternatives.

3. It is likely that recent (ie. last 50 years) sediments deposited in the harbor are somewhat contaminated and should be put in the diked disposal area. However, old (ie. hundreds to thousands years) glacial lake and preindustrial sediments and rock will be uncontaminated and chemically acceptable for open-lake disposal. Available boring logs were examined for indication of the presence of old sediments and rock within the project.

4. The logs indicated that parts of the project area does contain ancient glacial lake-laid materials and rock which would be acceptable for lake disposal. Thus, the northern end of the outer harbor channel appears to have predominantly clean glacial lake silts, sands and clays in addition to considerable limestone which would have to be excavated. This ~4,700 foot long by ~1,500 feet wide section must be deepened by ~5 feet. Further testing may be in order to demonstrate the chemical acceptability for open-lake disposal. Another ~4,200 foot x 1,500 feet wide channel section towards the southern end of the channel must also be deepened by ~5 feet. This section does not contain rock but appears to have considerable volumes of clean glacial-lake materials. This sector should also be tested for chemical acceptance for open-lake disposal.

5. The remainder of the outer harbor channel (~15,000 feet) must be excavated by one to two feet to reach proposed project depth. Although there will be some clean sediments, separation of clean from contaminated sediments will probably be difficult. This material would appear best suited for diked disposal.

6. Approximately three additional feet of Buffalo River sediments must be excavated to reach project depth. Historical pollution of Buffalo River sediments would make it advisable to contain these sediments in the dike disposal facility.

7. In no instance would it appear that containment any more stringent than the diked disposal area would be necessary. None of the sediments sampled in 1981 had organic contaminants in concentrations greater than 1-2 ppm, and generally organic contaminants were at less than 1 ppm. Heavy metal contaminants are intimately associated with the dredged sediments and would be isolated from the open-lake by settling of sediments in the dike disposal area.

Exhibit H-6

NCBED-HQ
SUBJECT: Buffalo Harbor Sediments

8. The estimated cost of a sampling and analyses program to ascertain the pollutant contents of recent and old outer harbor bottom materials and evaluate for open-lake versus diked disposal is 30 to 35 thousand. This would consist of 3-4 core sample transects in the channel sectors to be excavated five feet, with analyses of two to three discrete layers within each core.

Richard Leonard

R. LEONARD

8/2175

NCBPD-ER 25 June 1982

Stephen J. Raiche, Director
Historic Preservation Field Services
Division for Historic Preservation
New York State Office of Parks
and Recreation
Empire State Plaza, Agency Building 1
Albany, NY 12238

Dear Mr. Raiche:

Enclosed for your review and comment is a draft report entitled Cultural Resources Preliminary Assessment for the Buffalo Harbor Commercial Navigation and Debris Removal Studies. This report was done in partial fulfillment of Executive Order No. 11593 and the National Historic Preservation Act.

If we do not receive comments from you within 30 days of your receipt of this letter, we will assume that you are in agreement with the contents of the report.

If you have any questions, please contact Mr. Tim Daly at (716) 876-5454, extension 2175.

Sincerely,

1 Incl
as stated

CHARLES E. GILBERT
Chief, Planning Division

CF:
NCBPD-ER

Daly
McDermott
Bryniarski
Bennett
Switala
Conley
Sanders
Gilbert

Exhibit H-7

LB/2175

NCBPD-ER 25 June 1982

Dr. Robert E. Funk, State Archaeologist
New York State Museum and Science Service
Anthropological Survey
Albany, NY 12234

Dear Dr. Funk:

Enclosed for your review and comment is a draft report entitled Cultural Resources Preliminary Assessment for the Buffalo Harbor Commercial Navigation and Debris Removal Studies. This report was done in partial fulfillment of Executive Order No. 11593 and the National Historic Preservation Act.

If we do not receive comments from you within 30 days of your receipt of this letter, we will assume that you are in agreement with the contents of the report.

If you have any questions, please contact Mr. Tim Daly at (716) 876-5454, extension 2175.

Sincerely,

1 Incl
as stated

CHARLES E. GILBERT
Chief, Planning Division

CF:
NCBPD-ER

Daly____
McDermott____
Bryniarski____
Bennett____
Switala____
Conley____
Sanders____
Gilbert____

Exhibit H-8

DISPOSITION FORM

For use of this form, see AR 340-15, the proponent agency is TAGCEN.

REFERENCE OR OFFICE SYMBOL	SUBJECT
NCBED-PN	Trip Report - Observing and Touring the MESABI MINER at Buffalo, NY

TO Files

FROM J. Karsten, Study Mgr
M. Pelone, Economist

DATE 1 Oct 80 CMT 1
Pelone/sw/2178

1. At 0900 hours on 21 Sep 80, Mike Pelone and Jim Karsten traveled to the Buffalo Harbor to observe a 1,000 footer enter the south entrance channel enroute to the Lackawana Canal and Bethlehem Steel Corporation. The vessel was scheduled to be at the ore dock at 1100 hours, but actually arrived at 1300 hours. While waiting, we observed the SAGINAW BAY unloading gypsum at the NFTA facilities and the KINSMAN INDEPENDENT tied up at General Mills on the Buffalo Ship Canal; we also visited the Cargill elevators on the outer harbor and observed numerous recreational fishermen, and the diked disposal area No. One next to the NFTA small boat harbor.

2. At approximately 1200 hours, we sighted the inbound vessel and proceeded to walk up the Father Baker Bridge until we were directly over the Union Canal. The photos attached show a sequence of the MESABI MINER entering the south entrance channel. The attached map indicates the approximate course into the Lackawanna Canal. Vessel movements were not accurately timed but we estimate about 50-75 minutes from the time the vessel entered the Federal project to when it was finally tied up at the ore dock. The vessel speed throughout it's channel-entrance maneuvers appeared to be at "dead slow" with occasional use of the bow thruster. A good number of recreational craft were in this general area at this time. Once the vessel had passed us and began entering the Lackawanna Canal, we walked down from the bridge and proceeded to the entrance gate at Bethlehem Steel Corp.

3. After being granted access to Bethlehem Steel property by Mr. Dobson (Cleveland, OH), we were escorted by the guard to the ore docks where the MESABI MINER was about to tie up. We talked briefly to the ship's captain (Edward Rutkowski), who had to leave due to family business. He referred us to the first mate, John Jacobs, who talked to us for about two hours about the vessel, harbors, connecting channels, problem areas, winter navigation, etc. He also gave us a tour of the engine room and the material bins and conveyor system. The following is an accumulation of answers to questions and observations:

a. The MESABI MINER is a self-unloader with a 265-foot long conveyor; the crew complement is 31.

b. The tactonite pellets can be unloaded at the rate of 8,000 tons/hour (greater than 2 tons/sec).

c. The pellets are wetted to keep down dust during unloading and stockpiling operations; however, there was still a noticeable amount of airborne particulate matter over the deck of the ship.

d. On this trip, the vessel carried 56,622 tons at a draft of 27 feet from Superior, WI.

e. The vessel left Superior at 2100 hours on 9/17 and arrived at Lackawanna at 1115 hours on 9/21 (86 hours, 15 minutes). This is equal to a distance of 986 miles, or about 11.4 mph. No delays at the Poe lock were experienced on this trip.

Exhibit H-9

NCBED-PN
SUBJECT: Trip Report - Observing and Touring the MESABI MINER
at Buffalo, NY

f. From vessel records we observed that this ship carried 50,000 tons at 25'1" draft and 60,000 tons at 28'1" draft. Maximum trip capacities are realized between Escanaba, MI and Indiana Harbor.

g. They consider a wind less than 20 mph generally to be safe and manageable.

h. If winds and seas are unfavorable, the vessel will anchor offshore until the winds and waves diminish such that the vessel can enter the harbor safely.

i. The captain and first mate both feel that most, if not all, Great Lakes harbors are not designed for 1,000 footers. However, they also implied that the experience of individual vessel masters affects the perception of problems and needs at Federal harbors in the GL/SLS.

j. They feel each entrance or exit is a unique event and cannot be categorized.

k. They do not know what the squat, trim, and roll of the vessel is at any particular instant. Between origins and destinations, maximum safe drafts are provided to the captain before each trip from the corporate headquarters; changes in lake levels are not a matter of concern to the vessel master.

l. Suggested modifications to Buffalo Harbor consisting of a wider entrance would be preferable (i.e., to be accomplished by removing part of the south breakwater) along with a little more depth; lengthening the south entrance breakwater may also afford vessels more protection when entering the harbor, depending on wind direction and a turning basin to accommodate 1,000 footers.

m. There are more problems exiting Buffalo Harbor than entering because vessels back out of the Lackawanna Canal, then swing wide of the south breakwater, which does not give them a straight aproach through the relatively narrow (500-foot) entrance channel.

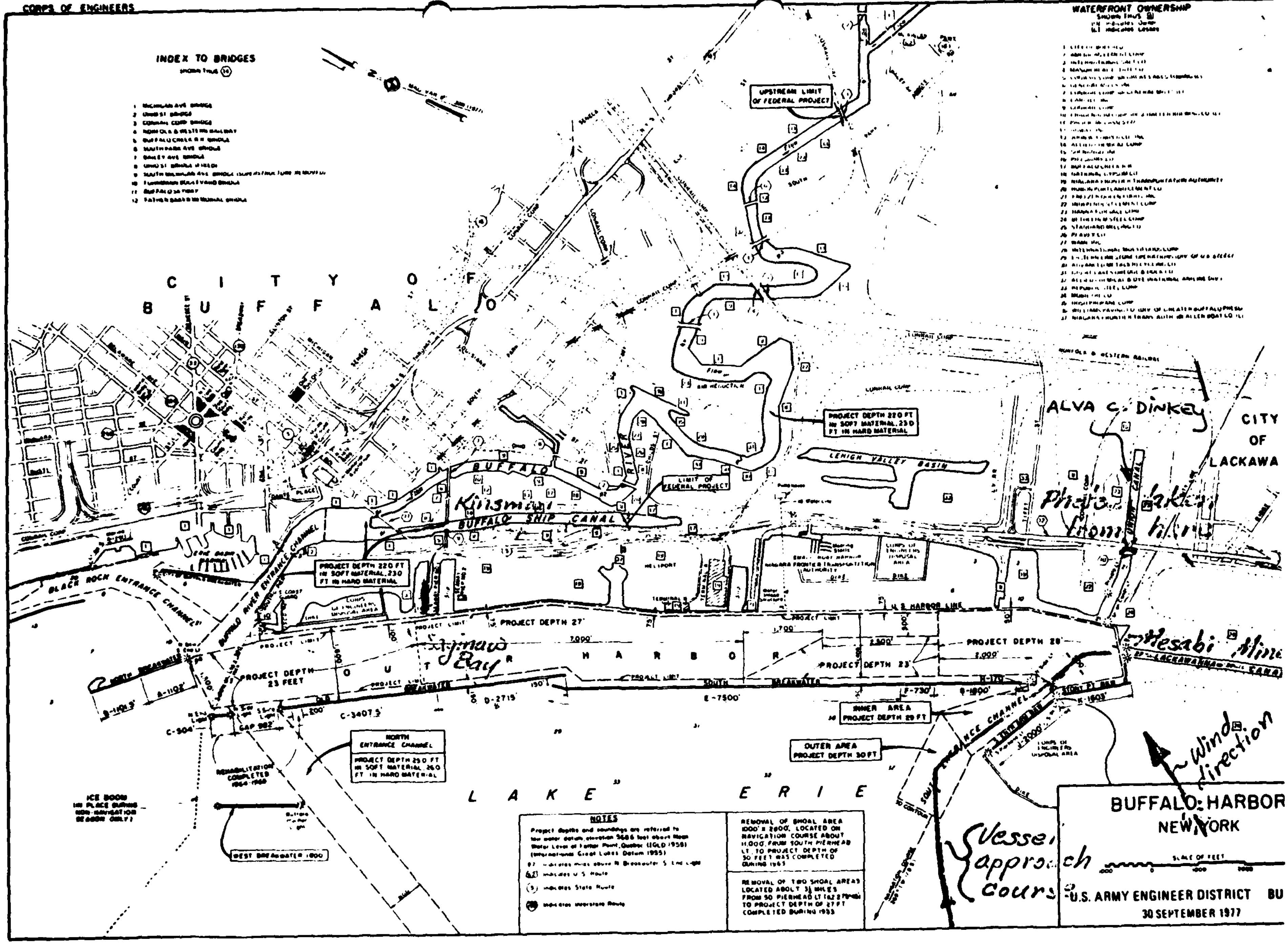
n. Each trip represents a unique trip contract; the crew does not have much advance notice of their next assignment.

o. Each vessel undergoes a hull inspection once every five years (this could be a problem in the future due to limited dry dock space in the Great Lakes ship yards).

p. When this vessel entered the Lackawanna Canal during its last trip, it struck the side and put a gash in the hull (above water level) in maneuvering around another vessel already in the canal.

M S Pelone
MIKE PELONE
Economist

Jim Karsten
JIM KARSTEN
Study Manager



CORPS OF ENGINEERS
INDEX TO BRIDGES
WATERFRONT OWNERSHIP
CITY OF BUFFALO
CITY OF LACKAWA
ALVA C. DINKEY
Photo taken from here
Kinsman
BUFFALO RIVER
BUFFALO SHIP CANAL
LEHIGH VALLEY BASIN
UPSTREAM LIMIT OF FEDERAL PROJECT
LIMIT OF FEDERAL PROJECT
PROJECT DEPTH 22.0 FT IN SOFT MATERIAL, 23.0 FT IN HARD MATERIAL
BLACK ROCK ENTRANCE CHANNEL
BUFFALO RIVER ENTRANCE CHANNEL
HELIPORT
U.S. HARBOR LINE
PROJECT DEPTH 27'
PROJECT DEPTH 28'
PROJECT DEPTH 23'
PROJECT DEPTH 23 FEET
OUTER HARBOR
Saginaw Bay
Mesabi Miner
LACKAWANNA CANAL
SOUTH BREAKWATER
NORTH BREAKWATER
NORTH ENTRANCE CHANNEL
PROJECT DEPTH 25.0 FT IN SOFT MATERIAL, 26.0 FT IN HARD MATERIAL
INNER AREA PROJECT DEPTH 29 FT
OUTER AREA PROJECT DEPTH 30 FT
SOUTH ENTRANCE CHANNEL
REHABILITATION COMPLETED 1964-1968
WEST BREAKWATER 1800
ICE BOOM IN PLACE DURING NON-NAVIGATION SEASON ONLY
LAKE ERIE
NOTES
REMOVAL OF SHOAL AREA 1000' X 2800', LOCATED ON NAVIGATION COURSE ABOUT 11,000' FROM SOUTH PIERHEAD LT. TO PROJECT DEPTH OF 30 FEET WAS COMPLETED DURING 1965
REMOVAL OF TWO SHOAL AREAS LOCATED ABOUT 3½ MILES FROM SO. PIERHEAD LT. TO PROJECT DEPTH OF 27 FT COMPLETED DURING 1955
Vessel approach course
Wind direction
BUFFALO HARBOR
NEW YORK
SCALE OF FEET
U.S. ARMY ENGINEER DISTRICT BU
30 SEPTEMBER 1977

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
HARRISBURG AREA OFFICE
100 Chestnut Street, Room 310
Harrisburg, Pennsylvania 17101

September 4, 1980

Mr. Donald M. Liddell
Chief, Engineering Division
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

This responds to your letter (NCBED-PE) of August 11, 1980, requesting information on the presence of threatened or endangered species or critical habitat in the Buffalo Harbor Study Area, Erie County, New York.

Except for occasional transient individuals, no federally listed or proposed species under our jurisdiction are known to exist in the study area. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act is required with the Fish and Wildlife Service (FWS). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to endangered species under our jurisdiction. It does not address other FWS concerns under the Fish and Wildlife Coordination Act or other legislation.

A list of federally listed endangered and threatened species in New York is enclosed for your information. Please contact us if we can be of further assistance.

Sincerely,

Norman R. Chupp

Norman R. Chupp
Area Manager

Enclosure

Exhibit H-10

Appendix I
Drift and Debris Removal Study

THE BUFFALO HARBOR

PRELIMINARY FEASIBILITY REPORT

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

October 1982

BUFFALO NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

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SECTION 1

THE STUDY AND REPORT

THE REPORT

This report is an appendix to the Buffalo Harbor Preliminary Feasibility Study. This appendix consists of a Main Report and a series of technical appendices. The Main Report summarizes the Preliminary Feasibility Study activities on drift and debris removal and is written to give the reader an understanding of the study and its outcome. It describes the study area, identifies the problems and needs associated with drift and debris removal; formulates alternative solutions; describes the economic, social, and environmental impacts of the alternatives; and identifies feasible alternatives. It also includes in summary form, the costs and benefits of the various alternatives, the plan implementation procedure and the division of project responsibilities between Federal and non-Federal interests. The report also provides the District's recommendations regarding further detailed study.

The seven appendices present the technical data which supports the information contained in the Main Report. The seven Appendices are:

Appendix	Title
A	Cost Estimate
B	Economics
C	Real Estate
D	Environmental
E	Legal
F	Cultural Resources
G	Correspondence

STUDY AUTHORITY

The original authority for the Drift and Debris Study came from the committee on Public Works of the House of Representatives in a resolution adapted 15 August 1961, which read as follows:

> "Resolved by the Committee on Public Works of the House of Representatives, United States. That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports heretofore submitted on Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor, New York, and Niagara River, New York, with a view to determining the advisability of establishing a separate project for the collection and removal of drift in the channels and tributary waterways."

The report that resulted from the above authority was the "Review Report on Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor, New York, Niagara River, New York, and Tributary Waterways for Collection and Removal of Drift," dated February 1965, by the U. S. Army Engineer District, Buffalo Corps of Engineers. This report was placed in the "deferred category" after a determination was made that there was no Federal interest in the project.

Since that report, similiar studies; Boston Harbor, Massachusetts, Feasibility Report on Debris Removal, dated December 1979 and the New York Harbor, Collection and Removal of Drift, Survey Report on Review of Project, dated June 1968, have resulted in favorable Corps projects. Based on these developments, the Buffalo District obtained approval to reactivate the drift removal study under the Buffalo Harbor Study authority and include it as an appendix to the Buffalo Harbor Preliminary Feasibility Study. It is emphasized that this study is only a supplementary effort. This study is completely subordinate to the overall commercial navigation study and is being included as an appendix to provide additional information on the study area. However, the recommendations of this report are completely separate and independent of those for the commercial navigation report.

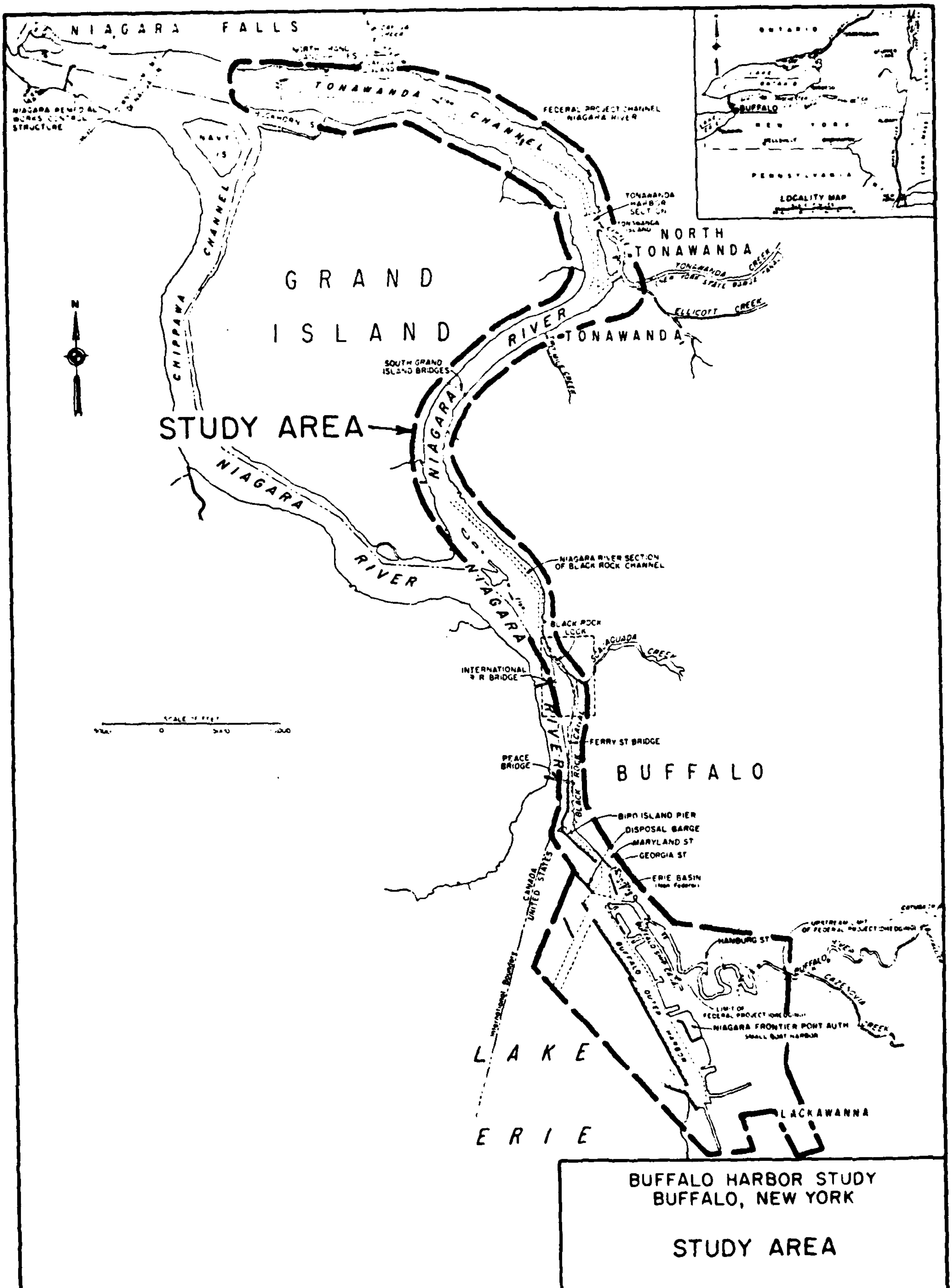
STUDY PURPOSE AND SCOPE

The purpose of this study is to determine the feasibility of establishing a project for the collection, removal, and disposal of drift from the study area. The study will also determine the feasibility of eliminating the sources of drift, such as tributary drift, dilapidated shorefront structures, loose onshore debris and derelict (wrecked) vessels.

The study area as shown by Figure 1 includes; the Buffalo Outer Harbor, the Buffalo Ship Canal, the Buffalo River, the Black Rock Canal, the East Branch of the Niagara River to the end of navigation and limited portions of the tributaries draining into the study area. The following communities are adjacent to the study area (from North to South): the city of Niagara Falls, the town of Wheatfield, the city of North Tonawanda, the city of Tonawanda, the Town of Tonawanda, the city of Buffalo and the city of Lackawanna.

The study will identify, inventory and presents plausible alternative solutions to the drift and debris problems of the study area. The depth and detail of the study are commensurate with the objective of selecting the most suitable alternative plans of development and determining their feasibility, giving consideration to the economic, legal, cultural and environmental factors. This report will present the results of the preliminary planning effort conducted to identify and analyze a wide range of alternative solutions to the drift problems of the study area. The alternative solutions were developed in enough detail to allow choices about which solutions should be carried forward for more detailed study. The study does not concentrate on detailed engineering or design considerations. However, the alternatives were developed in sufficient detail to:

- Identify all major components of each alternative



BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

STUDY AREA

U S ARMY ENGINEER DISTRICT BUFFALO

FIGURE 1

- Estimate the first costs of construction and the annual costs associated with each alternative

- Estimate the benefits associated with each alternative

- Assess the impacts of each alternative on the environment

At the conclusion of this preliminary feasibility report a recommendation will be made as to whether or not to carry any or all of the alternative plans into the next stage of study (developement of detailed plans). The recommended alternative plan(s) would then be developed in sufficient detail so that a rational choice could be made among them and if appropriate, an alternative could then be recommended for implementation.

PRIOR STUDIES AND REPORTS

The Review Report of Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor, New York, Niagara River, New York, and Tributary Waterways, For Collection and Removal of Drift, was the only prior report on Buffalo Harbor that has specifically dealt with the collection removal and disposal of drift. That report was placed in the differed category. However, over the years, the Buffalo District has done numerous navigation projects in the study area. The following paragraphs contain a general description of the Corps of Engineers projects within the waterway area considered in this report.

The existing Buffalo Harbor Project shown on Figure 2 provides for:

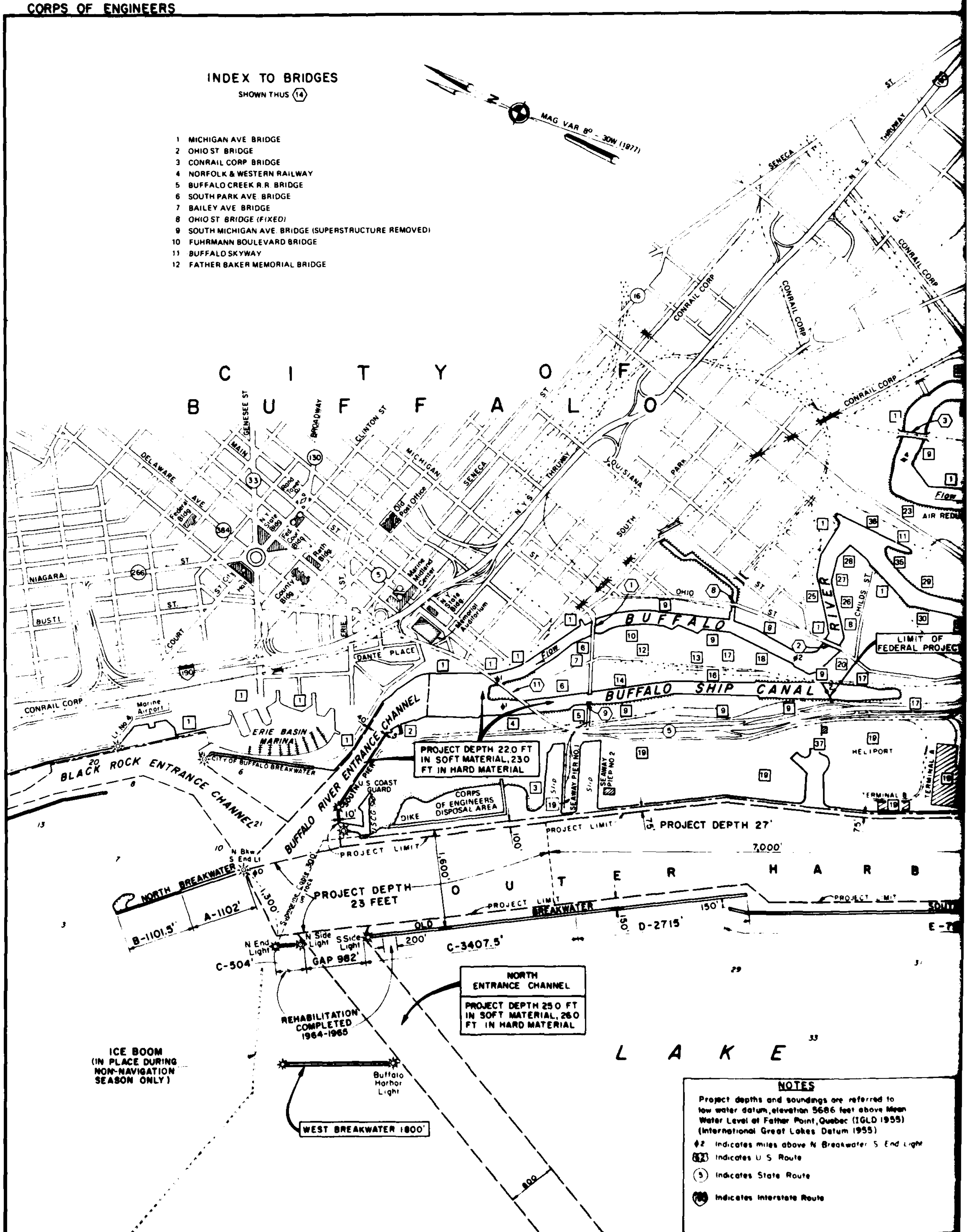
a. An outer harbor about 4-1/2 miles long and 1,600 feet wide formed by a breakwater system approximately parallel to shore with entrances at the north and south ends.

b. Depths of 28 feet in the southerly portion of the outer harbor, 27 feet in most of the middle and northerly sections and 23 feet in the remaining portion.

c. A South Entrance Channel consisting of: an outer channel 30 feet deep and 1,000 feet wide from deep water in the lake to a limit just lakeward of the south pierhead light; an inner channel 29 feet deep from the inner end of the outer channel converging to the 500-foot wide opening between the end of the south breakwater and the angle junction point of the South Entrance and the Stony Point Breakwaters; the inner channel then joining the 28-foot south outer harbor.

d. A north entrance channel protected by an 1,800-foot long detached breakwater, 800 feet wide with depths of 25 feet in soft material and 26 feet in hard material, from deepwater in the lake to the outer harbor.

e. Depths of 22 feet in soft material and 23 feet in hard material in the Buffalo River Entrance Channel from the outer harbor to the junction of Buffalo River and Buffalo Ship Canal.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SHOWN THUS (14)
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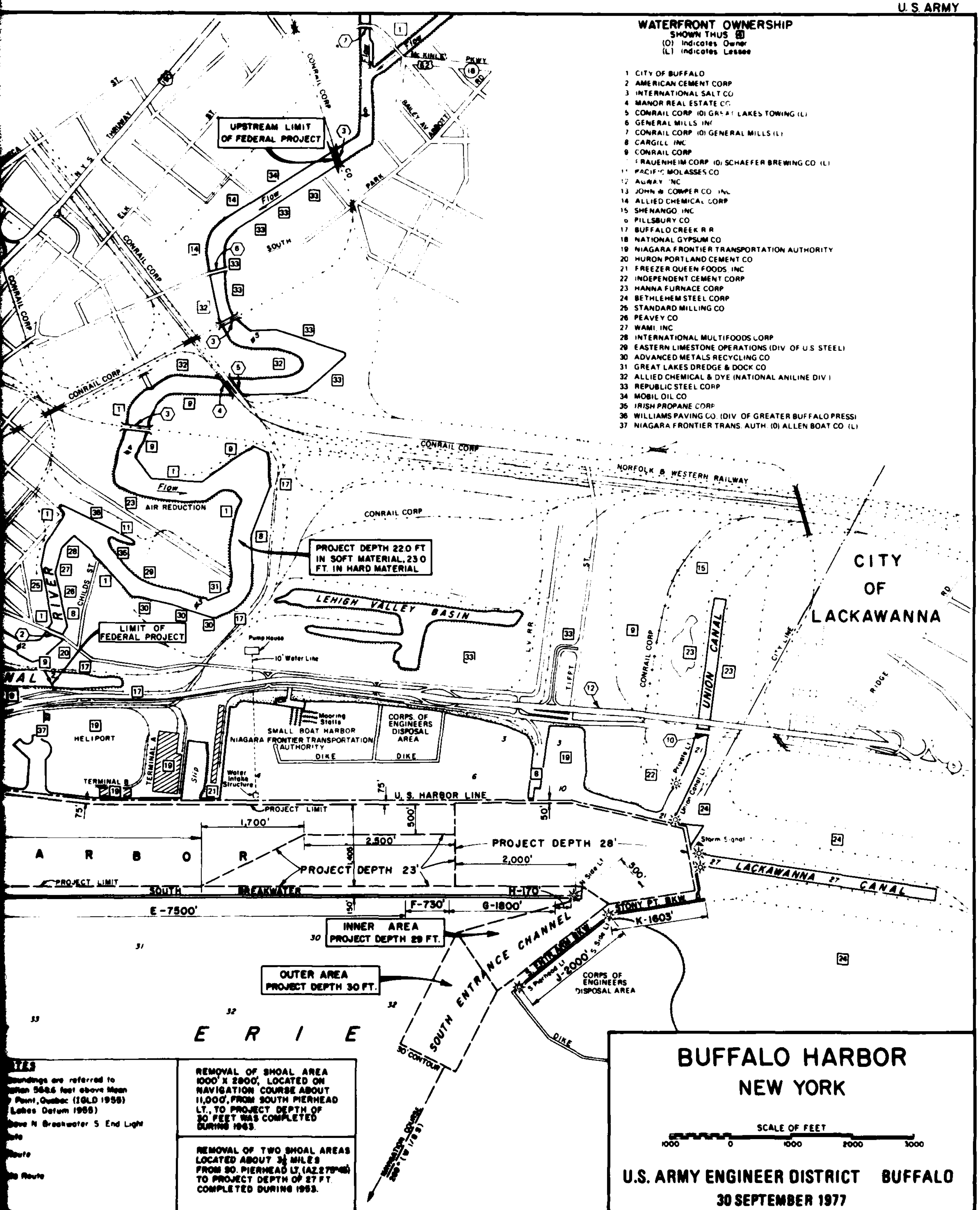
2 OHIO ST BRIDGE
3 CONRAIL CORP BRIDGE
4 NORFOLK & WESTERN RAILWAY
5 BUFFALO CREEK R.R. BRIDGE
6 SOUTH PARK AVE BRIDGE
7 BAILEY AVE BRIDGE
8 OHIO ST BRIDGE (FIXED)
9 SOUTH MICHIGAN AVE. BRIDGE (SUPERSTRUCTURE REMOVED)
10 FUHRMANN BOULEVARD BRIDGE
11 BUFFALO SKYWAY
12 FATHER BAKER MEMORIAL BRIDGE
MAG VAR 8° - 30W (1977)
CITY OF BUFFALO
BUFFALO RIVER
BUFFALO SHIP CANAL
LIMIT OF FEDERAL PROJECT
PROJECT DEPTH 22.0 FT IN SOFT MATERIAL, 23.0 FT IN HARD MATERIAL
BLACK ROCK ENTRANCE CHANNEL
BUFFALO RIVER ENTRANCE CHANNEL
ERIE BASIN MARINA
CITY OF BUFFALO BREAKWATER
CORPS OF ENGINEERS DISPOSAL AREA
U S COAST GUARD
SEAWAY PIER NO 1
SEAWAY PIER NO 2
HELIPORT
PROJECT DEPTH 27'
PROJECT LIMIT
OUTER HARBOR
NORTH BREAKWATER
PROJECT DEPTH 23 FEET
A-1102'
B-1101.5'
C-504'
GAP 982'
C-3407.5'
D-2715'
N Bkw S End Lt
N End Light
N Side Light
S Side Light
NORTH ENTRANCE CHANNEL
PROJECT DEPTH 25.0 FT IN SOFT MATERIAL, 26.0 FT IN HARD MATERIAL
REHABILITATION COMPLETED 1964-1965
ICE BOOM (IN PLACE DURING NON-NAVIGATION SEASON ONLY)
Buffalo Harbor Light
WEST BREAKWATER 1800'
LAKE
NOTES
Project depths and soundings are referred to low water datum, elevation 568.6 feet above Mean Water Level at Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955)
⊕2 Indicates miles above N Breakwater S End Light
Indicates U S Route
Indicates State Route
Indicates Interstate Route



WATERFRONT OWNERSHIP
SHOWN THUS
(O) Indicates Owner
(L) Indicates Lessee
1 CITY OF BUFFALO
2 AMERICAN CEMENT CORP
3 INTERNATIONAL SALT CO
4 MANOR REAL ESTATE CO
5 CONRAIL CORP (O) GREAT LAKES TOWING (L)
6 GENERAL MILLS INC
7 CONRAIL CORP (O) GENERAL MILLS (L)
8 CARGILL INC
9 CONRAIL CORP
RAUENHEIM CORP (O) SCHAEFER BREWING CO (L)
MOLASSES CO
13 JOHN W COWPER CO INC
14 ALLIED CHEMICAL CORP
15 SHENANGO INC
PILLSBURY CO
17 BUFFALO CREEK R R
18 NATIONAL GYPSUM CO
19 NIAGARA FRONTIER TRANSPORTATION AUTHORITY
20 HURON PORTLAND CEMENT CO
21 FREEZER QUEEN FOODS INC
22 INDEPENDENT CEMENT CORP
23 HANNA FURNACE CORP
24 BETHLEHEM STEEL CORP
25 STANDARD MILLING CO
26 PEAVEY CO
27 WAMI INC
28 INTERNATIONAL MULTIFOODS CORP
29 EASTERN LIMESTONE OPERATIONS (DIV OF U.S. STEEL)
30 ADVANCED METALS RECYCLING CO
31 GREAT LAKES DREDGE & DOCK CO
32 ALLIED CHEMICAL & DYE (NATIONAL ANILINE DIV)
33 REPUBLIC STEEL CORP
34 MOBIL OIL CO
35 IRISH PROPANE CORP
36 WILLIAMS PAVING CO (DIV OF GREATER BUFFALO PRESS)
37 NIAGARA FRONTIER TRANS. AUTH (O) ALLEN BOAT CO (L)
UPSTREAM LIMIT OF FEDERAL PROJECT
PROJECT DEPTH 22.0 FT IN SOFT MATERIAL, 23.0 FT. IN HARD MATERIAL
LIMIT OF FEDERAL PROJECT
CONRAIL CORP
NORFOLK & WESTERN RAILWAY
LEHIGH VALLEY BASIN
AIR REDUCTION
CITY OF LACKAWANNA
UNION CANAL
LACKAWANNA CANAL
HELIPORT
TERMINAL B
SMALL BOAT HARBOR
NIAGARA FRONTIER TRANSPORTATION AUTHORITY
CORPS OF ENGINEERS DISPOSAL AREA
U.S. HARBOR LINE
PROJECT LIMIT
PROJECT DEPTH 28'
PROJECT DEPTH 23'
SOUTH BREAKWATER
E-7500'
F-730'
G-1800'
H-170'
J-2000'
K-1603'
STONY PT. BKW.
INNER AREA PROJECT DEPTH 29 FT.
OUTER AREA PROJECT DEPTH 30 FT.
SOUTH ENTRANCE CHANNEL
CORPS OF ENGINEERS DISPOSAL AREA
E R I E
30' CONTOUR
DIKE
REMOVAL OF SHOAL AREA 1000' X 2900', LOCATED ON NAVIGATION COURSE ABOUT 11,000' FROM SOUTH PIERHEAD LT., TO PROJECT DEPTH OF 30 FEET WAS COMPLETED DURING 1963.
REMOVAL OF TWO SHOAL AREAS LOCATED ABOUT 3½ MILES FROM SO. PIERHEAD LT (AZ.275°45') TO PROJECT DEPTH OF 27 FT. COMPLETED DURING 1953.
BUFFALO HARBOR
NEW YORK
SCALE OF FEET
U.S. ARMY ENGINEER DISTRICT BUFFALO
30 SEPTEMBER 1977

1 2

FIGURE 2

f. Channels with depths of 22 feet in soft material and 23 feet in hard material in the Buffalo River to the upper Erie-Lackawanna Railroad Company bridge and in the Buffalo Ship Canal, a distance of about one mile upstream from its confluence with Buffalo River, with project widths generally of 150 and 125 feet respectively.

Controlling depths are: 28 feet in the southerly portion of the outer harbor and 23 feet in the remainder; 29 feet in the south entrance channel and 25 feet in the north entrance channel; and 22 feet in the Buffalo River Entrance Channel, Buffalo River and Buffalo Ship Canal.

Black Rock Channel and Tonawanda Harbor, NY, is essentially the upper 13.5 miles of the Niagara River from its head at Lake Erie, Buffalo, NY, to and including Tonawanda Harbor, NY, shown on Figure 3. In general, the existing project provides for:

a. An entrance channel 21 feet deep from the Buffalo north entrance channel to the foot of Maryland Street, Buffalo, a distance of about 4,200 feet, with widths varying from 1,000 feet to 500 feet respectively and with a short branch channel to Erie Basin.

b. A channel 21 feet deep from Maryland Street to the ship lock at the foot of Bridge Street, a distance of 3.3 miles, with widths varying between 350 and 200 feet.

c. A ship lock at the foot of Bridge Street, Buffalo, NY, 625 feet long and 68 feet wide with a depth of 21.6 feet over sills at low-water and a lift of 5 feet.

d. A channel 21 feet deep and 400 feet wide in the Niagara River from the ship lock at Bridge Street to a natural deepwater pool, a distance of 3.4 miles; thence through natural deepwater for a distance of 4.7 miles.

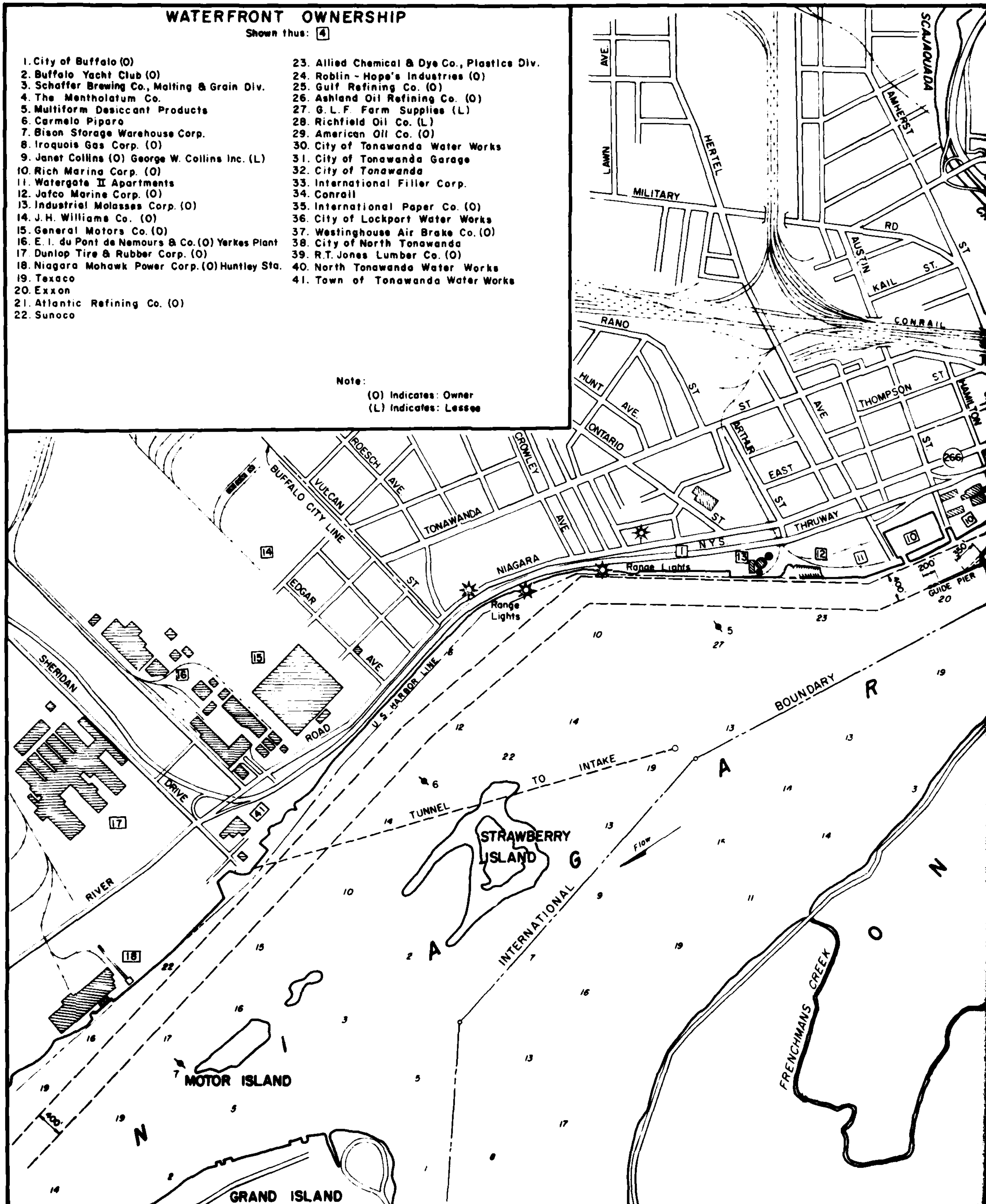
e. A channel 21 feet deep and 400 feet wide in the Niagara River on the west side of Tonawanda Island from the lower end of the deepwater pool to the foot of Tonawanda Island, North Tonawanda, a distance of 5,000 feet and ending in a turning basin of the same depth and about 1,230 feet long and 1,250 feet wide.

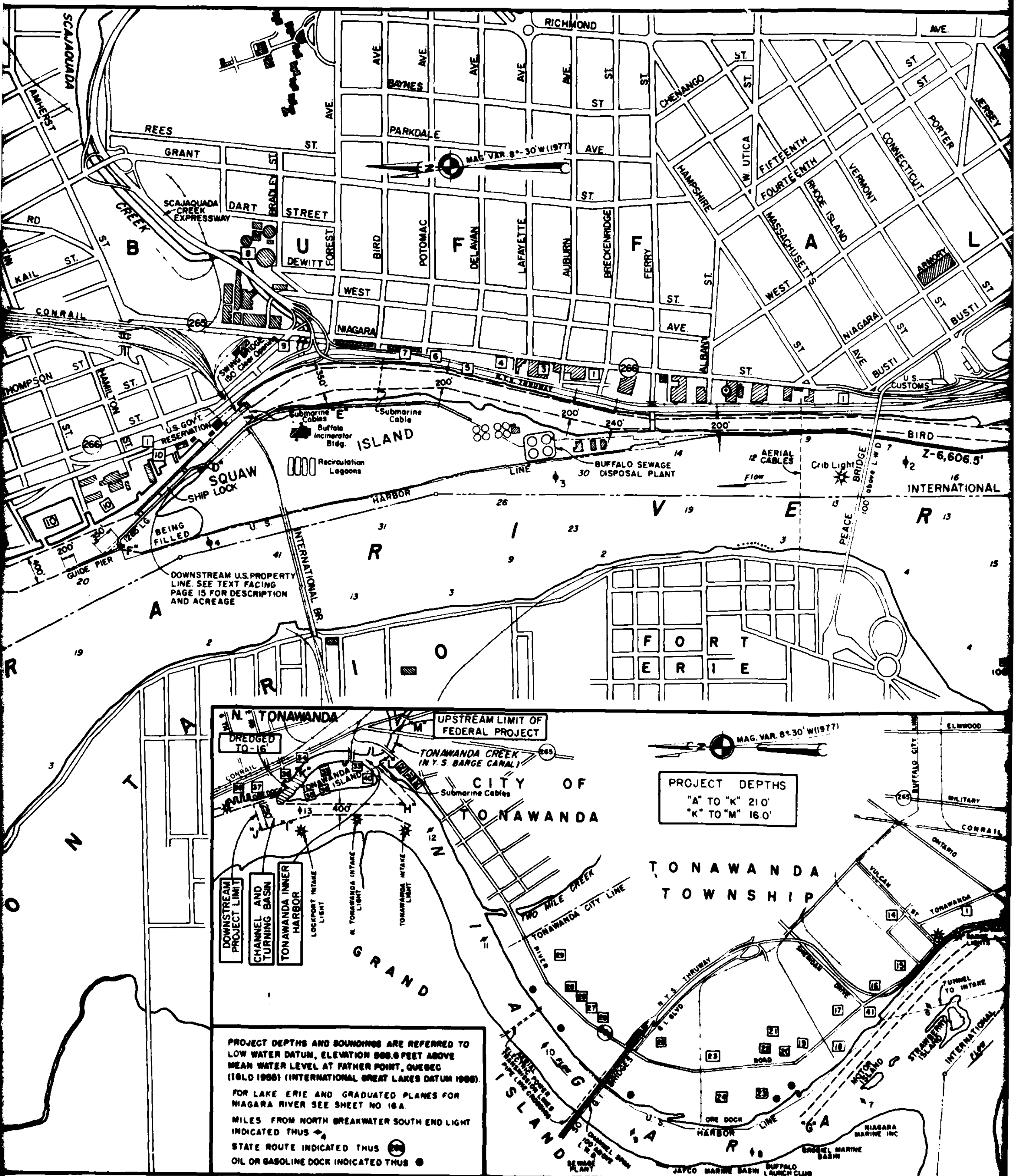
f. An inner harbor channel 6,800 feet long and generally 400 feet wide on the east side of Tonawanda Island, the lower 1,500 feet to be 21 feet deep and the remainder 16 feet deep.

g. A channel 16 feet deep, 1,400 feet long and generally 180 feet wide in the lower end of Tonawanda Creek. Controlling depths are: 21 feet in the channel above the ship lock, 20 feet in the Niagara River section and Tonawanda turning basin, 14 feet in Tonawanda inner harbor and 12 feet in the Tonawanda Creek Channel.

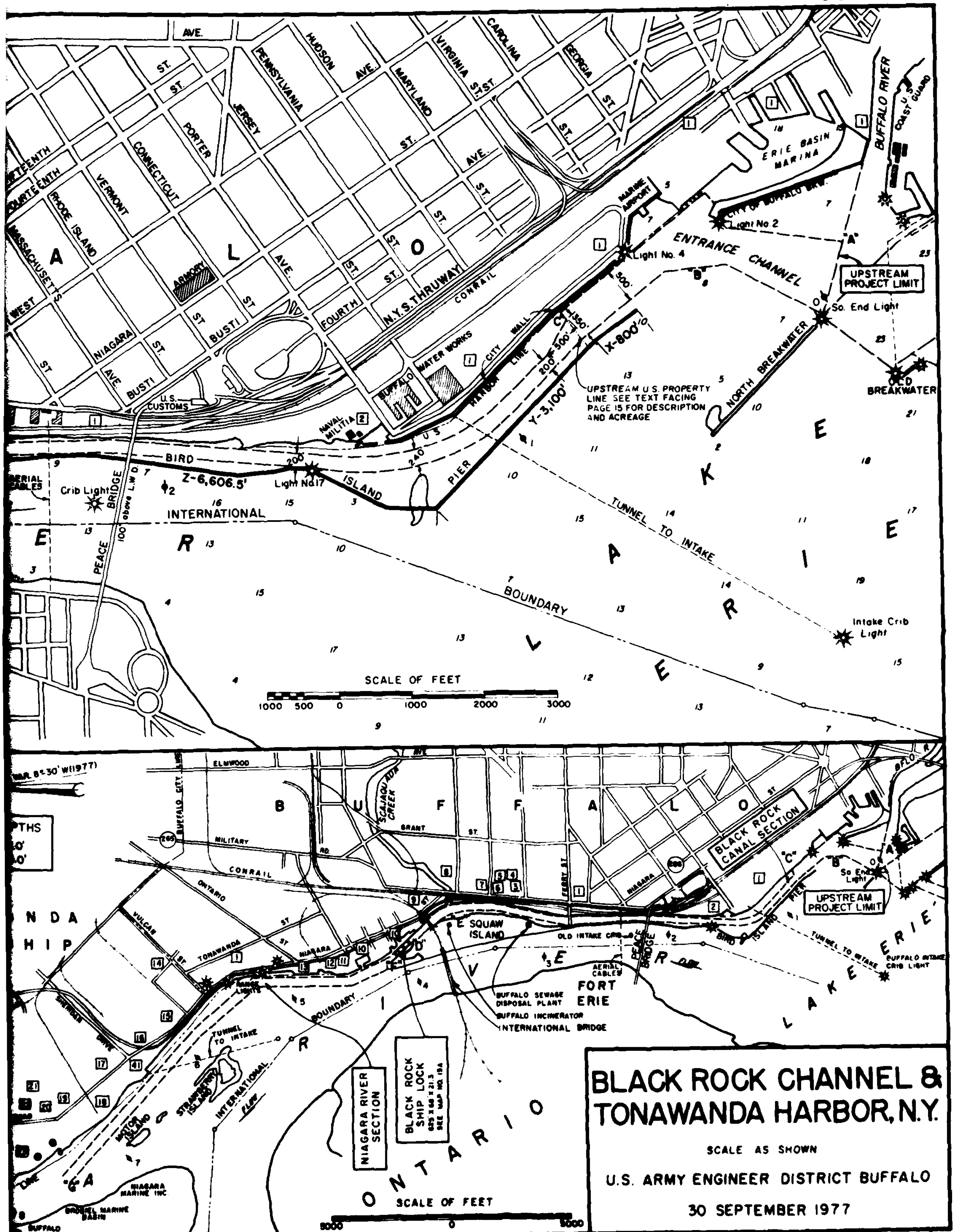
The Federal navigation project for Niagara River, NY, shown on Figure 4, consists of a channel 12 feet deep and 300 feet wide in Niagara River from

CORPS OF ENGINEERS





PROJECT DEPTHS AND SOUNDINGS ARE REFERRED TO LOW WATER DATUM, ELEVATION 568.6 FEET ABOVE MEAN WATER LEVEL AT FATHER POINT, QUEBEC (IGLD 1955) (INTERNATIONAL GREAT LAKES DATUM 1955).
FOR LAKE ERIE AND GRADUATED PLANES FOR NIAGARA RIVER SEE SHEET NO. 16A.
MILES FROM NORTH BREAKWATER SOUTH END LIGHT INDICATED THUS
STATE ROUTE INDICATED THUS
OIL OR GASOLINE DOCK INDICATED THUS
PROJECT DEPTHS
"A" TO "K" 21.0'
"K" TO "M" 16.0'
UPSTREAM LIMIT OF FEDERAL PROJECT
DREDGED TO -16'
N. TONAWANDA
TONAWANDA CREEK (N.Y.S. BARGE CANAL)
TONAWANDA ISLAND
Submarine Cables
CITY OF TONAWANDA
TONAWANDA TOWNSHIP
DOWNSTREAM PROJECT LIMIT
CHANNEL AND TURNING BASIN
TONAWANDA INNER HARBOR
LOCKPORT INTAKE LIGHT
N. TONAWANDA INTAKE LIGHT
TONAWANDA INTAKE LIGHT
TWO MILE CREEK
TONAWANDA CITY LINE
GRAND ISLAND
NIAGARA RIVER
N.Y.S. THRUWAY
MAG. VAR. 8°-30' W (1977)
BUFFALO
SCAJAQUADA CREEK EXPRESSWAY
CONRAIL
SWING BRIDGE 150' Clear Opening
U.S. GOVT. RESERVATION
SQUAW ISLAND
SHIP LOCK
BEING FILLED
GUIDE PIER
DOWNSTREAM U.S. PROPERTY LINE. SEE TEXT FACING PAGE 15 FOR DESCRIPTION AND ACREAGE
Submarine Cables
Submarine Cable
Buffalo Incinerator Bldg.
Recirculation Lagoons
BUFFALO SEWAGE DISPOSAL PLANT
AERIAL CABLES
Crib Light
PEACE BRIDGE 100' above L.W.D.
U.S. CUSTOMS
BIRD ISLAND
INTERNATIONAL
U.S. HARBOR LINE
INTERNATIONAL BR.
NIAGARA RIVER
FORT ERIE
ONTARIO
ARMORY
Z-6,606.5'
Flow
RICHMOND AVE.
RHODE ISLAND
VERMONT
CONNECTICUT
PORTER
JERSEY
MASSACHUSETTS
HAMPSHIRE
W. UTICA
FIFTEENTH
FOURTEENTH
CHENANGO
NIAGARA ST.
BUSTI AVE.
WEST AVE.
ALBANY
FERRY
BRECKENRIDGE
AUBURN
LAFAYETTE
DELAVAN
POTOMAC
BIRD
FOREST
DEWITT
BRADLEY
DART STREET
GRANT ST.
REES ST.
PARKDALE AVE.
BAYNES
AMHERST
THOMPSON ST.
HAMILTON ST.
KAIL ST.
SCAJAQUADA CREEK
ELMWOOD
MILITARY
BUFFALO CITY LINE
VULCAN
SHERIDAN DRIVE
E. L. BLVD
G. I. BRIDGES
AERIAL POWER LINES
ORE DOCK ROAD
HARBOR LINE
MOTOR ISLAND
STRAWBERRY ISLAND
TUNNEL TO INTAKE
RANGE LIGHTS
NIAGARA MARINE INC
GROSELL MARINE BASIN
BUFFALO LAUNCH CLUB
JAYCO MARINE BASIN
SEWAGE PLANT
CHANNEL SPAN 100' above L.W.D.



BLACK ROCK CHANNEL & TONAWANDA HARBOR, N.Y.

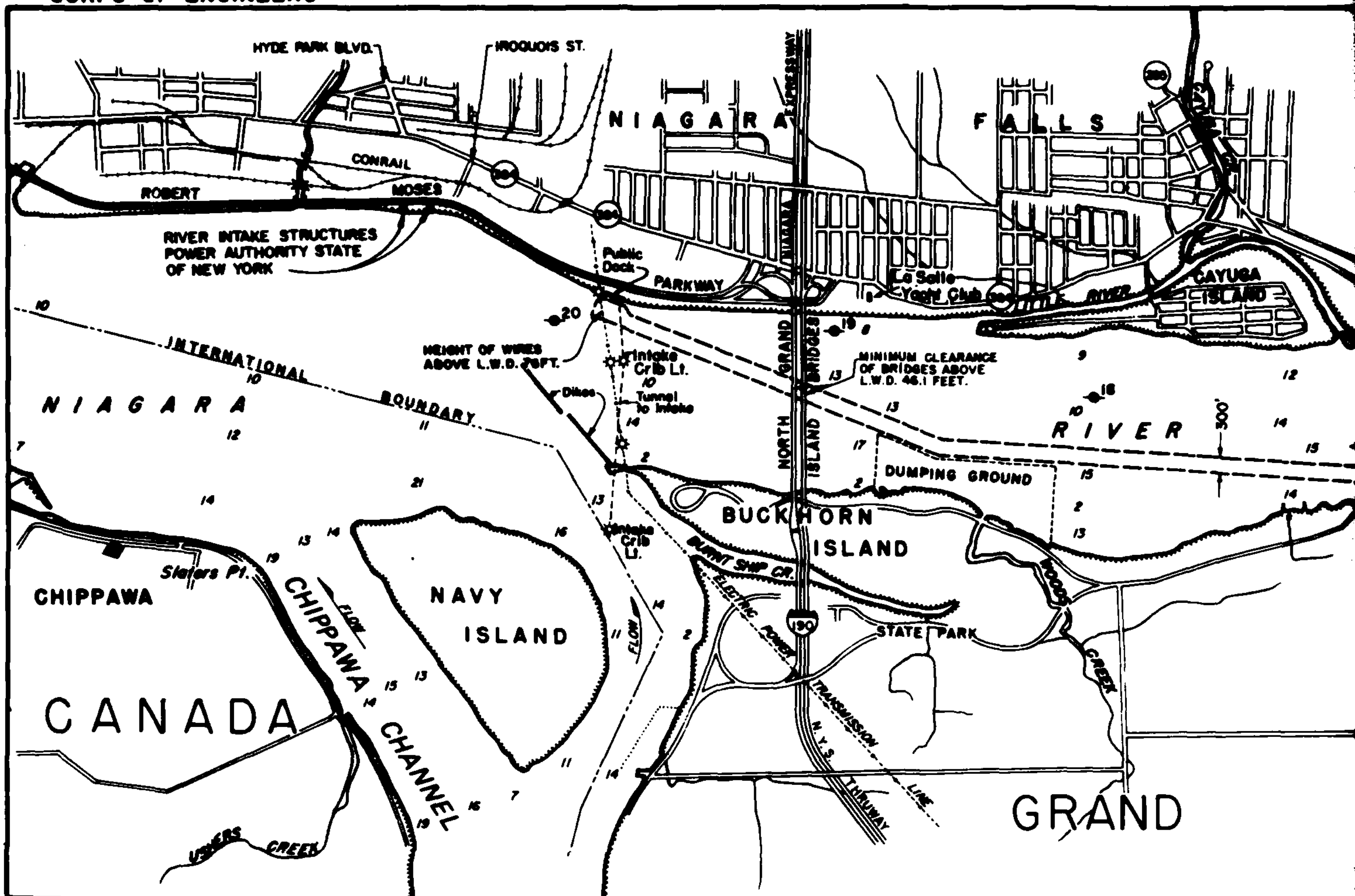
SCALE AS SHOWN

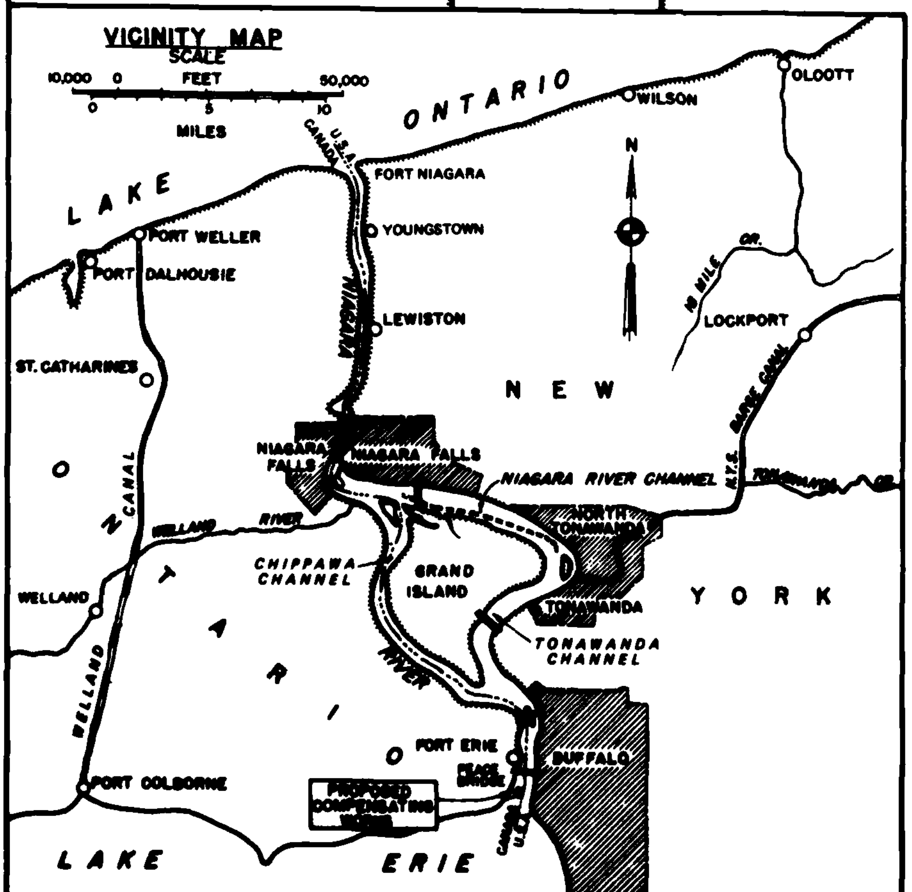
U.S. ARMY ENGINEER DISTRICT BUFFALO

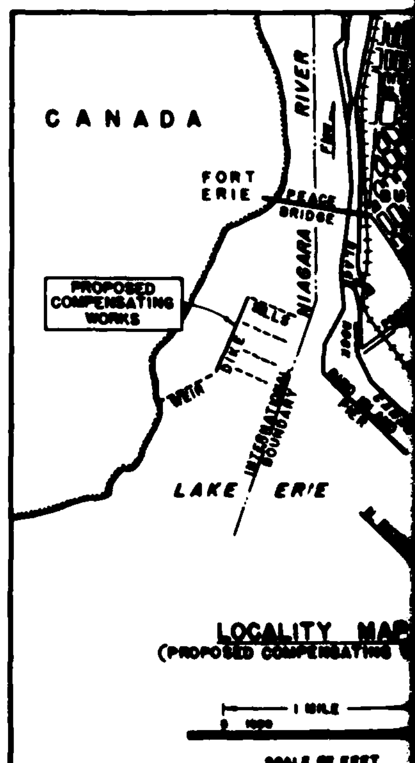
30 SEPTEMBER 1977

FIGURE 3

CORPS OF ENGINEERS



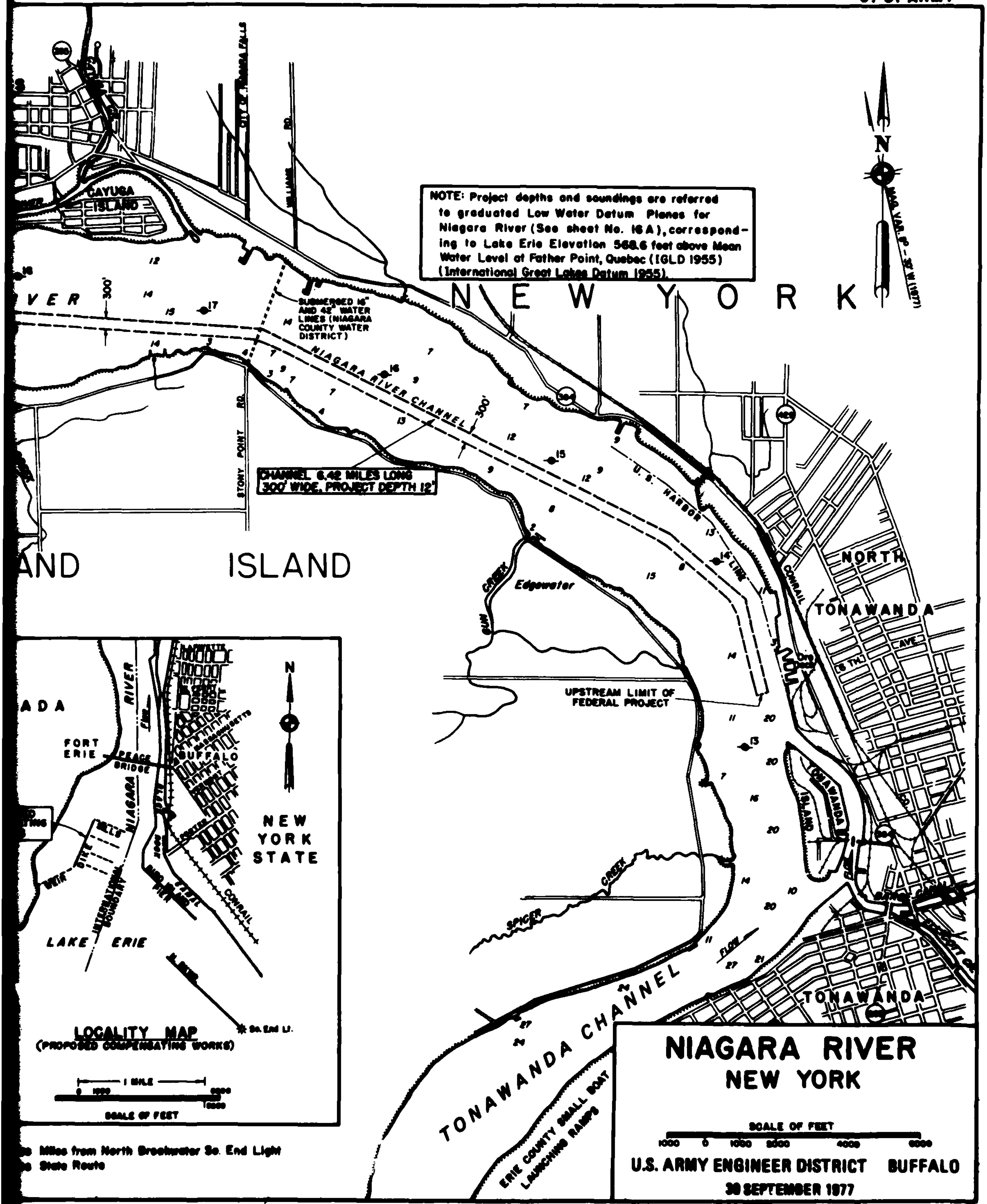




NOTES:

13 = Indicates Miles from North Breakwat

240 = Indicates State Route



NIAGARA RIVER
NEW YORK

FIGURE 4

the downstream end of the turning basin at Tonawanda Harbor, to opposite the lower end of Buckhorn Island. The controlling depth is 11.6 feet.

Little River, Cayuga Island, see Figure 5, is a Federally-improved entrance channel located at the mouth of Little River at the lower end of Cayuga Island at Niagara Falls, NY. The channel provides access to Little River, a narrow branch of the Niagara River and to Cayuga Creek which enters Little River about 4,000 feet upstream from the inner end of the entrance channel. The existing project provides for an entrance channel 8 feet deep and 1,200 feet long from the 8-foot depth in Niagara River to the same depth in the lower end of Little River, with widths varying from 200 feet at the outer end to 50 feet at the Little River end.

STUDY PARTICIPANTS AND COORDINATION

Several organizations were contacted during the initial stages of the study. These organizations were; the U.S. Coast Guard, the city of Tonawanda, the Buffalo Sewer Authority, the city of Buffalo, the Niagara Frontier Transportation Authority, local marinas and boat repair shops. These organizations were contacted for information on parts of the study that concerned them. Their comments on the study as a whole were not solicited at that time.

A news update was sent out in July of 1982 specifically dealing with the Drift and Debris Removal Study. The news update was sent to all of the participants in the Buffalo Harbor Study.

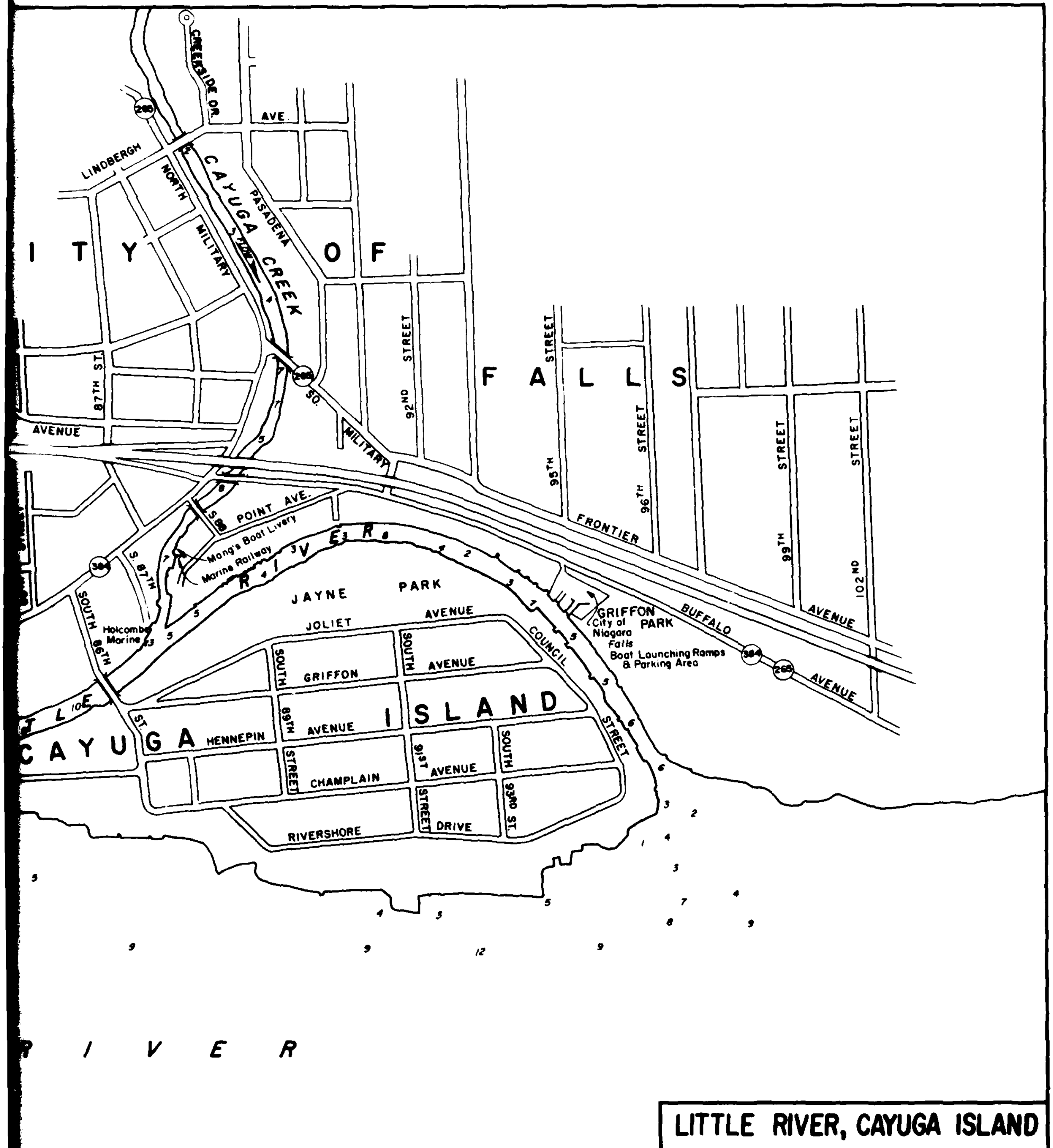
An information meeting was held in August of 1982 on the Buffalo Harbor Study and the Drift and Debris Removal Study. The minutes from that meeting are contained in Appendix of the Buffalo Harbor Study.

The final revitalization report (May 1981) briefly evaluated debris removal as an improvement measure. During the winter of 1981-1982, a survey of area public agencies, insurance companies, marinas, and marine operations was undertaken to gather information on drift and debris-related damages.

United States Fish and Wildlife Services (USFWS) were coordinated with regarding endangered species and the regional office has provided a Planning Aid Letter for this phase of the study (see Appendix Gd, Correspondence). The New York State Department of Environmental Conservation (NYSDEC) has also supplied a letter of comment on the Drift and Debris Removal Study (see Appendix Gd).

A notice of availability will be printed in the local papers and copies of this report will be sent to the Erie and Niagara County Libraries. Views of the public are being solicited through the review period for this document.

CORPS OF ENGINEERS



NOTES:

Project depths and soundings are referred to Low Water Datum for this section of Niagara River, Elevation 561.1 feet which corresponds to Low Water Datum for Lake Erie at elevation 568.6 feet above Mean Water Level at Father Point, Quebec (IGLD 1955) (International Great Lakes Datum 1955).

(384) Indicates State Route Nos.

LITTLE RIVER, CAYUGA ISLAND

NIAGARA FALLS, NEW YORK

SCALE OF FEET

400 0 400 800 1200 1600

U. S. ARMY ENGINEER DISTRICT BUFFALO

30 SEPTEMBER 1977

FIGURE 5

1 2

SECTION 2

PLAN FORMULATION

PROBLEM IDENTIFICATION

The presence of floating drift in the study area constitutes a distinct menace to small-boat navigation. Great numbers of small craft make use of the Buffalo Outer Harbor, Lake Erie, and the Niagara River. The boat operators must exercise care in navigating to avoid striking drift. The drift is most prevalent in the early spring following the winter thaw and at various times during the summer following severe rain and wind storms. The greatest difficulty for small-boat navigation is experienced at night or during fog conditions when the presence of drift is difficult to discern. Large commercial vessels experience little or no difficulty in navigating because of drift. In addition to navigation difficulties, other problems caused by drift and drift sources are: the unpleasant aesthetic effect of the shorefront cluttered with debris, decaying marine structures, and abandoned vessels; the hindrance to the utilization of the shorefront for commercial and recreational purposes; the interference with the operation of the Black Rock Lock; and the cloging storm sewer outfall chambers.

a. Historical Setting.

The historical development of the city of Buffalo is intricately tied to its harbor functions. The waterfront played a significant role in the development of the city. For more than a century, between 1830 and 1950, the Port of Buffalo was the hub of the city's economic life. Buffalo had profited from its location as the terminus of the Erie Canal, from its access to the economic heartland through the Great Lakes, from cheap energy at nearby Niagara Falls, and from its railroad links to the great markets of North America.

The opening of the Panama Canal in 1914, the growing use of alternative inland waterways, and the opening of the Welland Ship Canal as part of the St. Lawrence Seaway rerouted significant lake traffic away from Buffalo. By 1939, the Port of Buffalo supported 60 terminals for handling all types of cargo. Demand on goods generated by World War II kept cargos in coal, steel, limestone, oil, and grain at high levels. By 1946, Buffalo had declined to fifth in importance of the Great Lakes ports and 12th of all ports in the United States.

At present, a combination of new projects and plans are being implemented with the aim towards redevelopment of the waterfront. The Erie Basin Marina, Waterfront Village, the Shoreline Apartments, the Naval and Servicemen's Park, Tifft Farm Nature Preserve, and the River Walk are among the ongoing projects which are gradually changing the face of the modern waterfront from a predominantly industrial character towards more emphasis on residential and recreational usages.

b. Environmental Setting.

(1) Location - The study area is located at the easterly end of Lake Erie at the head of the Niagara River, and includes parts of the Niagara River up to the city of Niagara Falls, NY, as shown previously on Figure 1. The study area includes the Buffalo Harbor, Black Rock Lock, and Tonawanda Channel, and the Tonawanda Channel section of the Niagara River.

(2) Land - The topography of the study area is generally flat, with some gently sloping land and depressions that form marshy areas. The city of Buffalo is located in an area of glacial deposits of till and clay overlying limestone. However, the areas immediately adjacent to the water contain soils that exhibit artificial characteristics, because they have been extensively excavated, filled, and graded.

(3) Climate - The study area has a humid continental climate characteristic of most of the eastern United States. However, because of the proximity of Lake Erie, temperatures are moderate, producing higher relative humidity and precipitation as well as stronger winds. Temperatures vary from the 80's to well below zero. Snowfall averages around 93 inches per year. The most striking climatological factor in the area is wind, with an average monthly speed of 12.5 miles per hour.

(4) Air and Water Quality - The project lies within a heavily developed area with numerous industries such as steel mills, grain milling, chemical production and trucking companies, all of which have varying degrees of impacts on the air and water quality.

The air quality is indicative of densely populated, commercial office buildings, department stores, and industries in large metropolitan complexes or areas of heavy industry.

The Buffalo River and Buffalo Harbor area have historically been polluted by many point and nonpoint sources. The Niagara River was considered to be relatively clean and pollution-free. However, this may not be the case. Recent Canadian investigations seem to indicate there may be a number of pollutants present in the Niagara River which could have an effect on the present water quality.

(5) Population - The primary study area is the Buffalo Standard Metropolitan Statistical Area (SMSA), which contains the counties of Erie and Niagara. The population of the two-county area has declined in the last decade as has the population of New York State. The State change from 1970-1980 was -3.8 percent; the Buffalo SMSA's change was -7.9 percent during the same period. The city of Buffalo accounted for a large portion of this drop (-22.7 percent) with the other major city in the area, Niagara Falls, accounting for the second largest portion of the drop (-16.6). Only Niagara County, excluding the city of Niagara Falls, had a rate of decline similar to that of the State as a whole (-3.7). Erie County has been showing a continuous decline since 1971 and the Niagara County population has been fluctuating annually within this same period. The outlying counties in the area have shown an increase in population with Allegheny, Cattaraugus, Genesee,

Orleans, and Wyoming growing, and Erie, Niagara, and Chatauqua losing population (U. S. Department of Commerce, Bureau of Census.)

Erie County had 263,944 families and 365,217 households according to 1980 Census data. The county's population is broken down into 532,234 females with a median age of 33.4, and 483,238 males with a median age of 30.0. About 12 percent of Erie's population is age 65 or over. Approximately 27 percent of the county's population os 17 years old or under.

Niagara County's 80,258 households include 60,621 families. There are 117,716 females and 109,638 males in the county. There are 21,127 people age 65 and over (about 12 percent), and 63,254 persons 17 years old or under which approximately 28 percent of the county's population.

(6) Business and Industry - The economy of the two-county area is built on steel, grain, automotive, transportation, and power production with a diversity of manufacturing operations. Niagara Falls is a leading center of the nations metallurgical industry and is an important producer of chemicals and abrasives. Buffalo is also an important area for research with approximately 11,000 persons employed by 150 research laboratories in the area.

(7) Land Use - The Buffalo Harborfront area is characterized mostly by a mix of vacant and industrial land. The 700 acres of vacant tracts in the area results largely from urban renewal clearance efforts in the 1950's and 1960's. Much of the cleared land had been used by industry and port-related activities that lost their competitive edge during the course of this century and often left the area. Of these industries that remain in the harbor area, grain milling, related food processing, and the port are the most significant.

c. Existing Conditions. The following paragraphs briefly describe the existing conditions as they relate to the drift problems in the study area.

Action by the Department of the Army in removing debris from the study area is limited, in general, to the removal and disposal of these materials from the channels in the interest of the safety of general navigation covered under the Maintenance and Operations programs. The drift is most prevalent in the early spring following the winter thaw. During the spring of each year the Buffalo District, as part of its operation and maintenance program, removes accumulated drift and debris from upstream of the Black Rock Lock and the adjacent channels. This is done to ensure the operation of the Black Rock Lock. This work is being performed by a 30-ton derrick boat and tug. Material lying in the shallow areas outside of the channels or along the shores is not gathered.

The Buffalo Sewer Authority presently removes drift and debris from sewer outfalls that get clogged every spring. The outfalls are equipped with trash racks to prevent drift from entering the outfall. Trash accumulates at these traps and reduces flow out of the outfall.

The amount and location of drift in Buffalo Harbor is dependent to a great extent on weather conditions and the season of the year. During the spring

thaw and following heavy rainfall or periods of strong wind, large amounts of drift enters the study area. Winds cause the drift to shift location and collect in many different areas depending on wind direction. One day an area may be completely inundated with drift, and if the winds change direction, the same area may be clear the next day. Despite these conditions under the prevailing winds, most of the debris tends to accumulate at predictable locations along the shoreline; at bridges, small inlets, the Black Rock Lock, and other locations where features of riverbanks or structures form traps for floating material. The location of these areas is identified on Plates 2-7.

An attempt was made to determine the sources and location of drift in the study area. A field survey of the study area was made in the summer of 1981. During this survey, the location and sources of drift were inventoried. A summary of the inventory is shown on Table 1. Inventory maps were also developed, which identified the location, condition, and major classification of debris. These maps are shown on Plates 2-8.

The sources of drift and debris were placed into five general categories which are:

- Tributary Drift

- Waterfront Structures

- Derelict Vessels

- Loose Onshore Debris

- Abandoned Grain Elevators

A description of each of these types of sources follows:

(1) Tributary Drift - The tributaries are a major source of drift in the study area. Most of the material making up the drift was composed of masses of tree limbs, branches, small boards, with occasional trees and remains of waterfront structures (see Photos 1 and 2). The drift collects in the tributaries throughout the year, however, it is transported to the study area generally during the spring, when the flow in the tributaries increases.

(2) Waterfront Structures - All waterfront structures were examined in the field and their condition was classified as being one of the following: excellent, good, fair, partially dilapidated, and wholly dilapidated. All structures whose condition was classified as fair or better were dropped from further consideration as a source of drift. A partially dilapidated structure is one that is in disrepair such that it is a source of drift, but can be repaired. Table 1 summarizes debris by type for the communities within the study area. Sites 7, 9, 11, 18, and 31 were identified in the inventory as sources of drift where the waterfront structures are in a partially dilapidated condition. These sites have a total volume of 10,500 cubic feet. Whereas a dilapidated waterfront structure is fallen into such a state of ruin or decay as to be considered more practical to entirely remove than to repair. Typical examples of partially dilapidated and dilapidated structures

Photo 1. Tributary Drift in Scajaquada Creek. (5/82)

Table 1 - Summary of Volume and Type of Debris by Community

Type of Debris	Niagara Falls (cf)	Wheatfield (cf)	North Tonawanda (cf)	Town of Tonawanda (cf)	Buffalo (cf)	Total (cf)
Dilapidated Structures Heavy	100	765	-	-	100,650	101,515
Piles (assume 40-foot length)	-	8,100	2,600	1,200	38,650	50,550
Partially Dilapidated Structures	-	-	-	1,200	9,300	10,500
Abandoned Grain Mills	-	-	-	-	38,340,797	38,340,797
Dilapidated Structures Light	1,100	-	-	-	18,000	19,100
Derelict Vessels	-	-	-	-	30,875	30,875
Onshore Debris	100	1,000	-	-	175	1,275
Floating Debris (drift)	-		-	-	3,050	3,050
Total	1,300	9,865	2,600	2,400	200,700 (1)	216,800 (1)

(1) These totals do not include the volumes of material in the grain mills.

are Sites 7 and 27, Photos 3 and 4, respectively. Random groups of piles are considered in the same category as dilapidated structures. There are 35 sites identified in the study area in the dilapidated condition totaling 141,600 cubic feet.

(3) Derelict Vessels - There are two derelict vessels, one of steel and one of wood construction, in the study area. These are shown on Plates 4 and 5. These vessels are in the Buffalo Harbor and have a volume of approximately 30,900 cubic feet.

(4) Loose Onshore Debris - Almost throughout the entire study area, there are quantities of floatable debris that is just in the water or just above the waterline (see Photos 5 and 6). This material is deposited in the early spring when the usually high flows recede, leaving behind the material that gets trapped on the shore. Generally, there are large accumulations of onshore debris during the spring and early summer. Eventually, during the navigation season, this material finds its way back into the navigation channel during high water events.

(5) Abandoned Grain Elevators - Six abandoned grain elevators were identified in the inventory. These structures may cause a hazard to commercial navigation from nonfloating debris (see Photos 7 and 8) because of their vicinity to the water. These structures are directly adjacent to the navigation channel (see Plate 8). Since the opening of the St. Lawrence Seaway in 1958, grain storage and transfer operations in Buffalo effectively disappeared, leaving the community with an enormous problem regarding the future of the vacant and abandoned grain trade facilities (see Photos 9 and 10). The grain mills were built near the turn of the century and are massive reinforced concrete structures.

An estimate was made to determine the cost for demolishing the grain mills. The cost was approximately $30,000,000, or about $5,000,000 a piece (see Appendix A, Cost Estimate). The probability that these structures will interfere with navigation in the near future is very remote. These structures are not a major source of drift, as they are made out of concrete. Thus, because of the cost of removal and the fact that they are not a major source of drift, the abandoned grain mills will be dropped from future consideration in this study.

d. Future Conditions. The most probable future, as far as the sources of drift are concerned, is that the future conditions will probably be very similar to the existing conditions since the present sources of drift will probably not increase in number over time. However, there will probably be an increase in the yearly damages due to drift, because of the expected increase in use of the study area by recreational craft.

With respect to the grain mills and grain handling, the useful life of Buffalo's vacant storage and transfer elevators is over, and their revival is extremely remote. In a report, A Business Analysis of the Buffalo Milling Industry, the Erie County Industrial Development Agency (ECIDA) concluded that the local grain storage and transfer industry is an economic function of the past; that local initiatives to revive the industry are fruitless, and

Photo 2. Tributary Drift in the Buffalo River. (6/82)

Photo 3. Site No. 7, Partially Dilapidated Structure. (8/81)

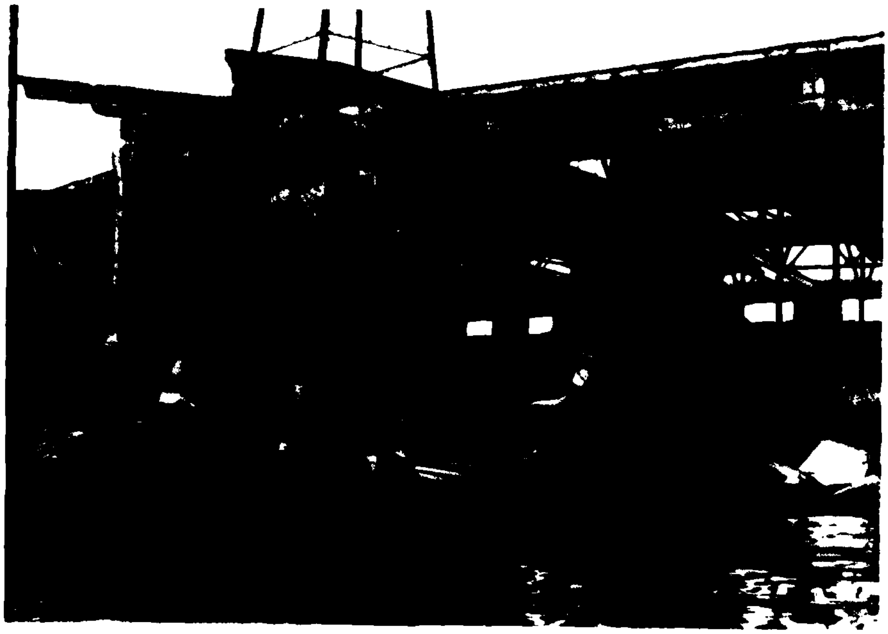


Photo 4. Site No. 27, Dilapidated Structure, Ganson Street Warehouse. (8/81)

Photo 5. Loose Onshore Debris, between Sites 10 and 11. (5/82)

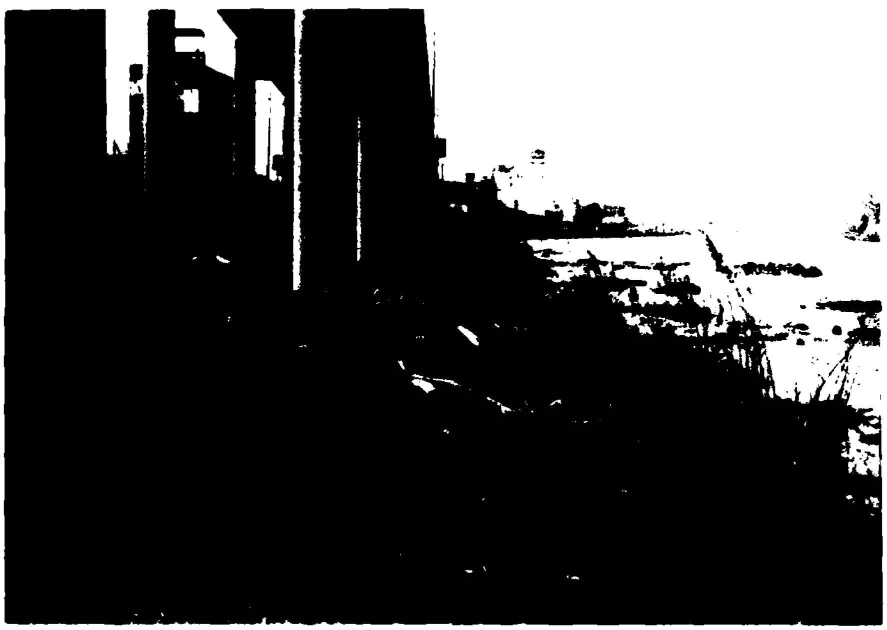


Photo 6. Loose Onshore Debris, between Sites 10 and 11. (5/82)

Photo 7. Abandoned Grain Elevator, Marine A (8/81, NOTE: Closeness to channel; see Plate 8)

Photo 8. Abandoned Grain Elevator. Note the closeness to channel. (8/81)

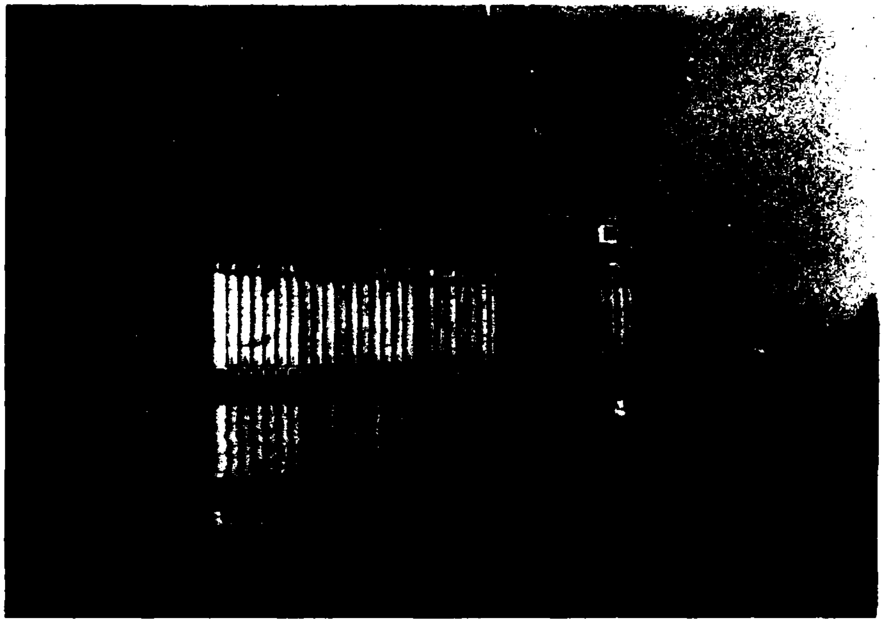


Photo 9. Cargill Pool Elevator, Capacity 2.0 Million Bushels. (8/81)

Photo 10. Concrete Central Elevator, Capacity 4.5 Million Bushels. (8/81)

that ". . . Buffalo would be better served to accept the fact that technologic change has ended an era."

The ECIDA went on to point out that there are several possible futures for the abandoned grain mills;

- Existing conditions of nonuse will continue.

- Recycling the structures by identifying an alternate storage use.

- Preservation of the structures for their historic significance.

- Structurally modify the facilities for an adaptive use.

- Demolish the structures.

The most probable future of the grain mills is that the existing conditions of nonuse and abandonment will continue.

PLANNING CONSTRAINTS

During this planning effort several planning constraints were identified which impacted on the conduct of the study and the formulation of alternative plans developed to remove drift from the study area.

There were two major planning constraints encountered in this stage of study. These were the difficulty in determining the locality where the damages occurred, and determining the source of the drift. These are discussed in the paragraphs below.

The damages that occur in a section of the study area may or may not be attributed to that section due to the mobility of the motor boats. For instance, a motor boat may strike drift in the Buffalo Harbor; however, it will be repaired at its home marina which may be in the city of North Tonawanda. Thus, the benefits that occur from the reduction in damages due to drift, would be assigned to the marina where the damages were repaired, not where the accident occurred. To determine where the damages occurred, it would require extensive interviews with individual boat owners, rather than interviewing all the marinas in the study area. The benefits to small-boat navigation from reduction in damages could not be broken up by localities at this stage of the study.

Another planning constraint at this stage of the study is the difficulty in determining the percentage of drift in the study area contributed by the tributaries vs. that contributed by the structural sources.

ALTERNATIVE PLANS

The development of alternative plans involves the determination of possible strategies for removal of drift from the study area, their evaluation and the selection of the plan(s) which best meets the goals of

national economic development (cost-effectiveness), environmental quality, social well-being, and regional development.

a. Evaluation Criteria.

The formulation of the best plan(s) involves a two-stage screening process. In the first stage, each alternative is screened as to its feasibility from a technical, regulatory, and commercial standpoint. All impracticable strategies are rejected and given no further consideration. In the second stage, each of the alternatives are then evaluated in terms of the criteria listed in the previous paragraph and the feasible plans are selected for detailed study. The following criteria were adapted for first stage screening.

- Is the plan of removal and disposal technically feasible using equipment and technology available in the study area?

- Is the plan of removal and disposal allowable under Federal, State, and local laws, regulations, and ordinances?

- Does the possibility exist for a positive net benefit on a preliminary basis.

- Is the plan acceptable to the general public so far as can be established?

The criteria for determining the feasible plan(s) in the second stage screening process were:

- Technical - Can the alternative be carried out using standard engineering methods and equipment available in the region?

- Economic - Is the benefit/cost ratio greater than 1? Does the plan maximize the benefits?

- Environmental - What are the positive and negative impacts on water quality, air quality, noise, fish and wildlife resources, land use, and aesthetics; and, are these compatible with local and regional land use plans.

- Social - Does the plan impact adversely on the benefits to different income, educational, or recreational groups? Are cultural opportunities community cohesion, urban renewal, employment, or the generation of taxes for local communities impacted adversely.

- Regional - Does the plan impact on port operation and development of the Buffalo Metropolitan Area?

b. Possible Solutions.

All possible solutions were based on two strategies:

- remove the drift as it appears in the study area; and

- determine the sources of the drift, and remove the major ones if possible.

The first possible solution is to remove the drift as it appears in the study area. This solution would involve continuously sweeping the study area throughout the navigation season and remove the drift as it accumulates. This would involve a floating plant of some sort to collect the drift. The drift would then have to be removed from the study area and disposed of in an approved manner. The study area is an estimated 11 square miles of semi-open water. While the plant was working in one section of the study area, drift accumulations in the other areas would be expected to continue; thus requiring the floating plant to continuously sweep the study area. The feasible means of disposal for this solution and all other solutions considered fall into one of three categories; destruction by burning, resource recovery or disposal by landfill.

Another solution considered was to remove the sources of drift. The drift in the study area originates in two general sources: These sources are; the tributaries and drift that originates in waterfront structures. A debris rack was considered for removal of drift from the tributaries. There are two major tributaries which are a source of drift in the study area. These tributaries are the Buffalo River and the Scajaquada Creek (see Plate 1). The debris rack on the Buffalo River was dropped during the first stage of screening for feasibility due to difficulties with flooding, disruption of navigation, prohibitive cost, and problems with ice floes. The most probable place for a debris rack on the Buffalo River is shown on Photo 11. The Scajaquada Creek is not a major source of tributary drift, as much of the drift is trapped upstream. Photo 12 is a picture of the debris rack on the creek upstream of the study area. This debris rack is in disrepair; however, measures by the local ownership are being made to improve the racks. Thus, the solution of removing tributary drift at the source was dropped from further consideration after the first stage of screening.

The alternative plans considered past the Stage 1 screening process were in general; to do nothing, to remove the drift in the study area as it appears; and to remove the sources of drift in the study area such as dilapidated waterfront structures, wrecked vessels, and loose onshore debris. Since it is impossible to remove all the drift from the study area at one time, another possible alternative is to clean up the structural sources of drift, such as dilapidated waterfront structures and to continuously remove the drift as it enters the study area from the tributaries. This alternative plan is essentially combining the other two plans. The following subsection describes the alternative plans in greater detail.

c. Alternative Plans.

The following alternatives were developed from the possible strategies that were discussed in the preceeding paragraphs.

(1) Alternative I - Take no further action than is being taken at the present time to collect drift. Presently, the only Federal work being done is an annual cleanup in the early spring, in and around the Black Rock Lock

Photo 11. Buffalo River upstream of Railroad Bridge and downstream of confluence with Cazenovia Creek, see Plate 7. (6/82)

Photo 12. Debris racks on the Scajaquada Creek, Cheektowaga. (6/82)

to eliminate hazards to navigation and to enable safe operation of the Lock gates. This is the "No Action" Alternative, and the base against which all alternative plans may be compared.

(2) Alternative II - Establish an annual program for the continuous removal of drift in the study area. The drift to be removed consists of trees, logs, limbs, and tree root masses; portions of deteriorated waterfront structures such as timbers and planks; and debris generated by human activity, such as cars, oil drums, boxes, ladders, chairs, cable reels, and miscellaneous trash.

The amount and location of drift in the study area is dependent to a great extent on weather conditions and the season of the year. During the spring after the thaw, and at various times following heavy rainfall or periods of strong wind, large amounts of drift enter the waterways. Strong winds cause the drift to shift location and collect in many different areas depending on wind direction. However, most of the drift tends to accumulate at predict-table locations along the shoreline, at bridges, small inlets, and other locations where features of river banks or structures form natural catch basins.

The drift would be collected by a shallow draft barge with a hoist and a launch. The equipment would be used continuously throughout the navigation season (approximately 6 months). It is estimated that approximately 35,000 cf of drift would be removed in one season. This material would be removed to a staging area where it would then be moved to a disposal area.

The feasible means of disposal for this alternative fall into one of three categories: destruction by burning; resource recovery; or disposal by landfill. The specific method for each of these categories is as follows:

- Destruction by a mobile total combustion unit.

- Reuse through burning of the debris in a furnace to produce energy for power plants, heating, or industrial processes. The Hooker Chemical Resource Recovery Facility in Niagara Falls, NY, is this type of facility.

- Place the debris in an existing landfill.

(3) Alternative III - Implement a one-time cleanup program to rid the study area of the major sources of drift. This plan consists of removing all sources of drift, including dilapidated and partially dilapidated structures, loose onshore debris, floating debris, and derelict (wrecked) vessels.

The removal consists of breaking up dilapidated waterfront structures such as pine wharves, sunken vessels, and piles of debris. There are different methods of carrying out this task. The plan does not need to define precisely the actual method of demolition, as this is best selected by the demolition Contractor in accordance with the equipment available to him.

The removal plan used for evaluation is based on the use of a 30-ton derrick boat (see Photo 13), and a caterpillar mounted hydraulic clamshell and

Photo 13. 30-Ton Derrick Boat Picking Up Drift and Debris. (6/80)

shallow draft barges (see Photo 14). The clamshell grabs pieces of superstructure, sunken vessels, or loose debris, breaks it off and loads it onto a barge, which is then unloaded into a staging and transfer area.

Piles can be pulled intact directly by the clamshell when they are in soft ground, or with the aid of a vibrator attached to the clamshell when deeply embedded in substrata. However many of the piles will have to be cut at the mudline - this is necessary in many of the cases to prevent the slope from becoming weakened. Many of the piles are situated in groups or clusters along the shore. Pulling the piles will leave a large volume of voids and this may weaken the slope sufficiently so that the slope could then fail, causing excessive erosion or endangering buidings.

The methods of disposal for this alternative would be the same as those for Alternative II.

(4) Alternative IV - Alternative IV is a combination of Alternatives II and III. This alternative consists of a one-time cleanup program to rid the harbor of the major sources of drift and a formal annual maintenance program to remove drift from the study area that has entered from the tributaries. The methods of disposal for this alternative would be the same as those for Alternative II.

d. Screening of Alternative Plans.

This subsection summarizes the second stage screening for the alternative plans. The alternative plans in this second stage screening process are screened for: technical feasibility; national economic development; environmental quality; social well-being; and regional development. This screening process is summarized below:

(1) Technical - All of the alternatives are technically feasible using standard engineering methods and equipment.

(2) National Economic Development - The economic analysis of the proposed alternative plans was developed by comparing the equivalent annual costs to the annual benefits for each plan.

(a) Benefits - The benefits of the proposed drift and debris program for Buffalo Harbor and the Upper Niagara River that were considered include navigation damages avoided, enhancement of property values, and reduced maintenance costs. Navigation benefits result from a reduction in the number of boat/drift collisions and a reduction in the debris removal costs and damages to marina facilities. Land enhancement benefits result from increased market value for existing property due to removal of drift and debris sources such as abandoned or dilapidated structures, waterfront facilities, etc. Maintenance reduction benefits result from reducing the cost to public agencies by eliminating drift. Table 2 is a summary of the average annual benefits occurring from the removal of drift and debris.

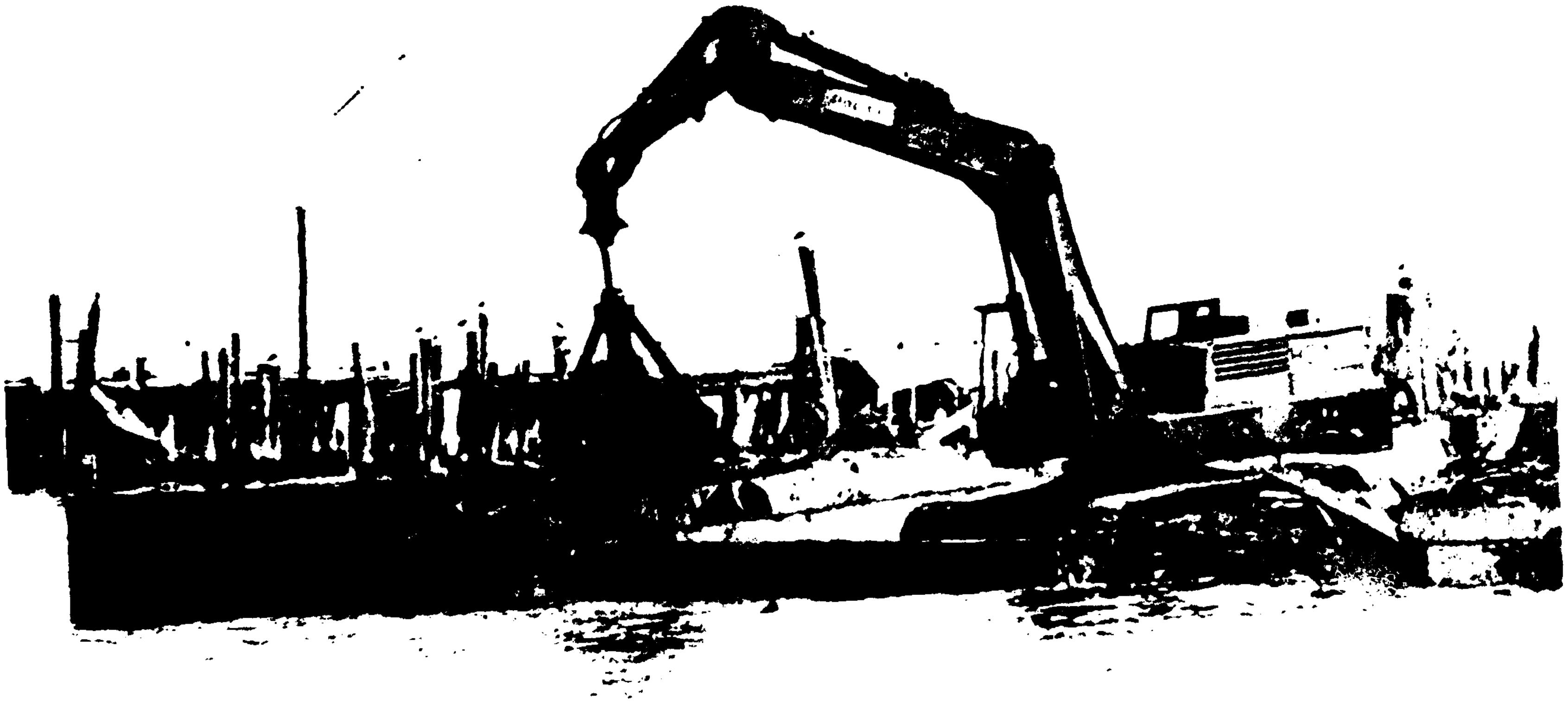


Photo 14. Barge Mounted Clamshell Picking Up Debris in New York Harbor

Table 2 - Summary of Average Annual Benefits

Benefit Category	Alternative II	Alternative III	Alternative IV
	$	$	$
Navigation	134,500	77,400	174,500
Property Enhancement	100	40,100	40,200
Reduction in Maintenance Costs	167,000	66,800	167,000
Total	301,600	184,300	381,700

(b) Costs - Estimates of project costs were developed for removal, collection, and disposal of materials for each project alternative, based upon the energy resource recovery disposal option, which is the least expensive disposal option. Removal includes the cost of transporting structures, wrecks, and onshore debris. Collection includes the cost of transporting drift material to the staging area. Disposal includes the cost of unloading, processing, and reloading material at the staging area and of transporting it to the disposal site. Table 3 is a summary of the average annual costs for the alternative plans.

Table 3 - Summary of Average Annual Costs

	Alternative II	Alternative III	Alternative IV
	$	$	$
Average Annual Costs	455,000	173,100	625,000

(c) Summary - The estimated average annual costs and benefits, the net benefits, and the ratio of benefits to costs for the alternative plans is presented in Table 4. The benefit to cost ratios for the different alternatives varies from .61 to 1.06:1. Alternative III has the only benefit to cost ratio greater than 1, and the only plan with positive net benefits.

Table 4 - Benefits and Costs Summary

Benefits/Costs	Alternative I: No Action Plan	Alternative II: Continuous Removal Plan	Alternative III: One-Time Removal Plan	Alternative IV: One-Time Clearance and Removal Plan
	$	$	$	
Total Estimated Avg. Annual Benefits	-	301,600	184,300	381,700
Total Average Annual Costs (1)	-	455,000	173,100	625,000
Net Benefits	-	-153,400	11,200	-243,300
Benefit/Cost Ratio	-	.66 to 1	1.06 to 1	.61 to 1

(1) Project costs reflect least cost disposal option of energy resources recovery at Niagara Falls, NY.

(3) Environmental Quality - The "No Action" Alternative would have no direct impact on environmental quality. Conditions would continue much as at the present time, debris sources slowly deteriorating and contributing to the floating debris in the harbor. New debris sources would be created as piers and boats were abandoned. However, some debris sources would be cleared to make way for redevelopment. No significant adverse impacts were discovered during the evaluation of the proposed plans. Alternative IV, the one-time cleanup and continuous removal of drift and debris has the most adverse and the most beneficial impacts. The "No Action" Alternative I has the least adverse and least beneficial impacts. The most beneficial impact of Alternative IV is the increased aesthetic appeal of the study area. The most adverse impact is that removing the drift removes some fish habitat. Hooker Chemical Energy Recovery, is the only disposal method with benefits as it would be effectively recycling the debris. The recovery method will save an alternate energy source such as oil or gas.

(4) Social Well-Being - The "No Action" Alternative will have no positive effect on social well-being. This alternative may have a negative effect by perpetuating the existing decay and urban blight that is characteristic of sections of the study area. Alternatives IV and III may enhance the general social well-being by providing a stimulus to harbor redevelopment and support for community revitalization. Alternative II does not provide the stimulus that Alternatives III or IV would to revitalization, but it does not have the negative impacts that the "No Action" Alternative would have.

(5) Regional Development - The development of the study area is inextricably related to the development efforts of the region, from the waterfront to the suburbs. All the alternatives, except the "No Action" Alternative will promote the revitalization efforts of the local communities.

e. Selection of a Feasible Plan.

Alternative III has the only positive net benefits which results in a benefit-to-cost ratio of greater than 1.

Based on the National Economic Development benefit-to-cost ratio, Alternative III is the only Alternative Plan which is economically feasible. There are no apparent negative environmental effects for Alternative III which would preclude continuing into more detailed studies. Alternative III has positive and social environmental effects which is improving the aesthetic appeal of the study area. Based on these considerations, Alternative III is the only feasible solution at this stage of study.

SECTION 3
MOST FEASIBLE PLAN

The feasible plan consists of clearing the Buffalo Harbor and adjacent waterways in the study area of the sources of drift in a one-time cleanup. This drift is a hazard to navigation, clogs sewer outfalls, and prevents the safe operation of the Black Rock Lock gates. This plan will remove the major sources of drift in the study area excluding tributary drift. The sources of drift include dilapidated and partially dilapidated structures, loose onshore debris, sunken vessels and drift. The quantity of material to be removed is approximately 216,800 cubic feet as shown on Table 5. The locations of the identified sources of drift are shown on Plates 2-7.

Table 5 - Total Volume of Debris, by Source

Type of Source	Volume (Cubic Feet)
Dilapidated Structures	171,200
Partially Dilapidated Structures	10,600
Derelict Vessels	30,900
Onshore Debris	1,000
Drift	3,100
Total	216,800

The method of removal that the estimate is based on is by a 30-ton derrick boat, a mounted hydraulic clamshell and shallow draft barge. However, the low bidder for the demolition contract will be allowed latitude in selecting a removal method which does not have any significant negative impacts. This is intended to increase competition in bidding.

The debris will be removed from the site as described in the above paragraph, loaded onto shallow draft barges and transported to a staging area. The staging area has not been identified in this phase of study, however, there are numerous vacant open industrial sites adjacent to the study area that can be used as staging areas. At the staging area the material will be unloaded from the barges and temporarily stored. The material will then be loaded onto trucks and transported to the disposal site.

The disposal site chosen for the cost analysis was the Hooker Chemical "Energy From Waste" Plant, a resource revovery facility. This method of disposal was chosen because it is the least expensive method and it has virtually no adverse impacts on the environment. Since the disposal method

would provide energy, a certain amount of an alternate fuel could be saved. The NYSDEC also suggested that the resource recovery method of disposal at the Hooker Plant be used. Choosing a different disposal method will not alter the plan or change the benefit-to-cost ratio significantly.
This plan will not reduce drift completely, since the tributary drift will still be entering the harbor. However, removing these sources will significantly reduce the drift in the harbor. It is estimated that drift will be reduced by about 40 percent. The significant evaluated accomplishments that would result from this plan of improvements are:

a. Improvement to navigation and a substantial reduction in boat/debris collisions in the study area.

b. The enhancement of waterfront sites encouraging redevelopment.

c. The completion of one necessary task in the urban renewal program of the city of Buffalo.

d. The reduction of the existing maintenance program for the Black Rock Lock and the sewer outfalls.

The selected plan is expected to reduce the amount of drift by 40 percent resulting in an average annual savings of $77,400 in repairs due to boat/debris collisions. The calculated value of the annual enhancement of waterfront sites is estimated to be $40,000. The calculated value of the annual maintenance reduction is $67,000.

The risks and uncertainties involved in this plan are as follows: the removal of some of the shorefront structures may cause erosion on the banks, especially in the Buffalo River. The pilings and wharves may be acting as a deterrent to erosion. There exists a possibility that the inventory of the sources is not complete, finding these sources will add costs to the project without creating significant benefits. On the other hand, plan optimization may increase the benefit-to-cost ratio significantly. A few of the sources may be contributing a majority of the drift making removal of those structures more cost effective.

In summary, the plan will produce social and economic benefits to the region. It will complete a necessary task in the urban renewal plans of the city of Buffalo and it will lower the cost of waterfront redevelopment and will provide an added inducement to draw private investment in the area.

SECTION 4

PLAN IMPLEMENTATION

INSTITUTIONAL REQUIREMENTS

A brief description of the steps that will be necessary to implement the plan of improvement for drift and debris removal from the Buffalo Harbor and adjoining areas as outlined in this report, can be summarized as follows:

This Preliminary Feasibility Report will be forwarded for review to the North Central Division of the Corps of Engineers. The report will then be released for public comment and review. After these comments are received and acted upon, the study will enter the final stage of study. In this stage the plan that was recommended for detailed study will be refined. The additional studies that will be performed in this stage of study will be; a reinventory of the study area; sample boat owners to determine if areas of high concentrations of damages can be found; determine the quantities of drift contributed by the tributaries; and determine if realignment of the study area will result in a more cost effective project. When this stage of the study process is complete a Draft Feasibility Report will be forwarded to the North Central Division and released for public comment. The study will then enter the final phase where a Final Feasibility Study with a selected plan will be done. The Final Feasibility Report resulting from this study will be reviewed by the North Central Division of the Corps of Engineers; the Board of Engineers for Rivers and Harbors; and the Office of The Chief of Engineers. The Chief of Engineers will transmit the report to the Governor of New York and other Federal agencies for formal review and comment. Following the above review, the final report of the Chief of Engineers will be forwarded to the Secretary of the Army who will obtain the views and comments of the Office of Management and Budget and then transmit the report to Congress.

DIVISION OF PLAN RESPONSIBILITIES

This section presents information regarding the various responsibilities of Federal and Non-Federal interest with respect to the most feasible plan. (Note that the ultimate items of cooperation are subject to changes that reflect cost-sharing and financial arrangements which are satisfactory to the President and the Congress): The discussion includes a summary of overall Federal and Non-Federal nonmonetary responsibilities. Also the current and proposed cost-sharing requirements for Federal and Non-Federal interests are presented.

a. Federal Responsibilities.

After Congressional authorization and funding, the Federal Government will undertake to design and implement the most feasible plan. Such design

will include the completion of all the studies and preparation of the reports documenting those studies, drawings, specifications, and contract documents. Implementation will include the preparation, and award of contracts, and supervision of all work until completion of the project.

b. Non-Federal Responsibilities.

In this subsection there will be two descriptions of the Non-Federal Responsibilities. The first will be the traditional responsibilities and the second will be the responsibilities as proposed by the Reagan Administration which are still under Congressional review.

(1) Traditional - Before Federal funds can be used for the removal and disposal of drift sources in the study area, a local sponsor must sign a contract with the Corps of Engineers agreeing to the following items of local cooperation:

(a) Provide without cost to the United States, all lands, easements and rights-of-way required for construction and future maintenance of the project.

(b) Hold and save the United States free from damages due to the construction and subsequent maintenance of the improvements except for damages due to the fault or negligence of the United States or its Contractors.

(c) Provide the transfer and disposal sites including suitable access thereto, or in the alternative provide other sites that meet the approval of the Chief of Engineers.

(d) Pass building codes and/or regulate use of the shoreline structures in the study area so that they do not become a future source of drift.

(e) Contribute a cash payment of one-third of the first cost for the removal of drift and debris such as derelict vessels, loose onshore debris, and drift which cannot be attributed to an identifiable owner, a sum presently estimated at $160,000.

(f) Contribute a cash payment of 100 percent of the first cost of removal of drift and debris which is attributable to an identifiable owner, a sum presently estimated at $1,650,000. These costs are shown on Table 6 - Traditional Apportionment of First Costs for the Most Feasible Plan.

Table 6 - Traditional Apportionment of First Costs for the Most Feasible Plan

Description	Total Cost	Federal Share	Non-Federal Share
	$	$	$
Identifiable Owners	1,650,000	-	1,650,000
Nonidentifiable Owners	480,000	320,000	160,000
Derelict Vessels			
Loose Onshore Debris			
Drift			
Total	2,130,000	320,000	1,810,000

(2) Proposed - This recommendation is made with the provision that prior to implementation, Non-Federal interests will, agree to comply with the following requirements:

(a) Same requirements as for the traditional requirements.

(b) Same requirements as for the traditional requirements.

(c) Same requirements as for the traditional requirements.

(d) Same requirements as for the traditional requirements.

Table 7 - Proposed Apportionment of First Costs of the Most Feasible Plan

Description	Total Cost	Federal Share	Non-Federal Share
	$	$	$
Identifiable Owners	1,650,000	-	1,650,000
Nonidentifiable Owners	480,000	-	480,000
Total	2,130,000	-	2,130,000

c. Legal Requirement.

The local cooperator(s) will be required to furnish, among other requirements, all lands, easements and rights of way. This shall include those lands which contain structures to be demolished. It is assumed that local cooperators would retain title, granting the United States the right - of-entry required to accomplish the necessary demolition. When the work is completed title could be transferred to the local Urban Development Agency. The local cooperator will also be required to furnish the right-of-entry required for the removal of onshore debris.

The two derelict vessels may be removed pursuant to Section 414 of Title 33 of the United States Code having been determined by this study to generate

debris which endangers navigation. It is unlikely that, at this point in time, it could be proved that the sinking of these vessels was willfull or negligent. Also, it is assumed that these vessels have been abandoned, however, the procedures in Section 209.190 of Title 33 of the Code of Federal Regulations will be followed prior to removal.

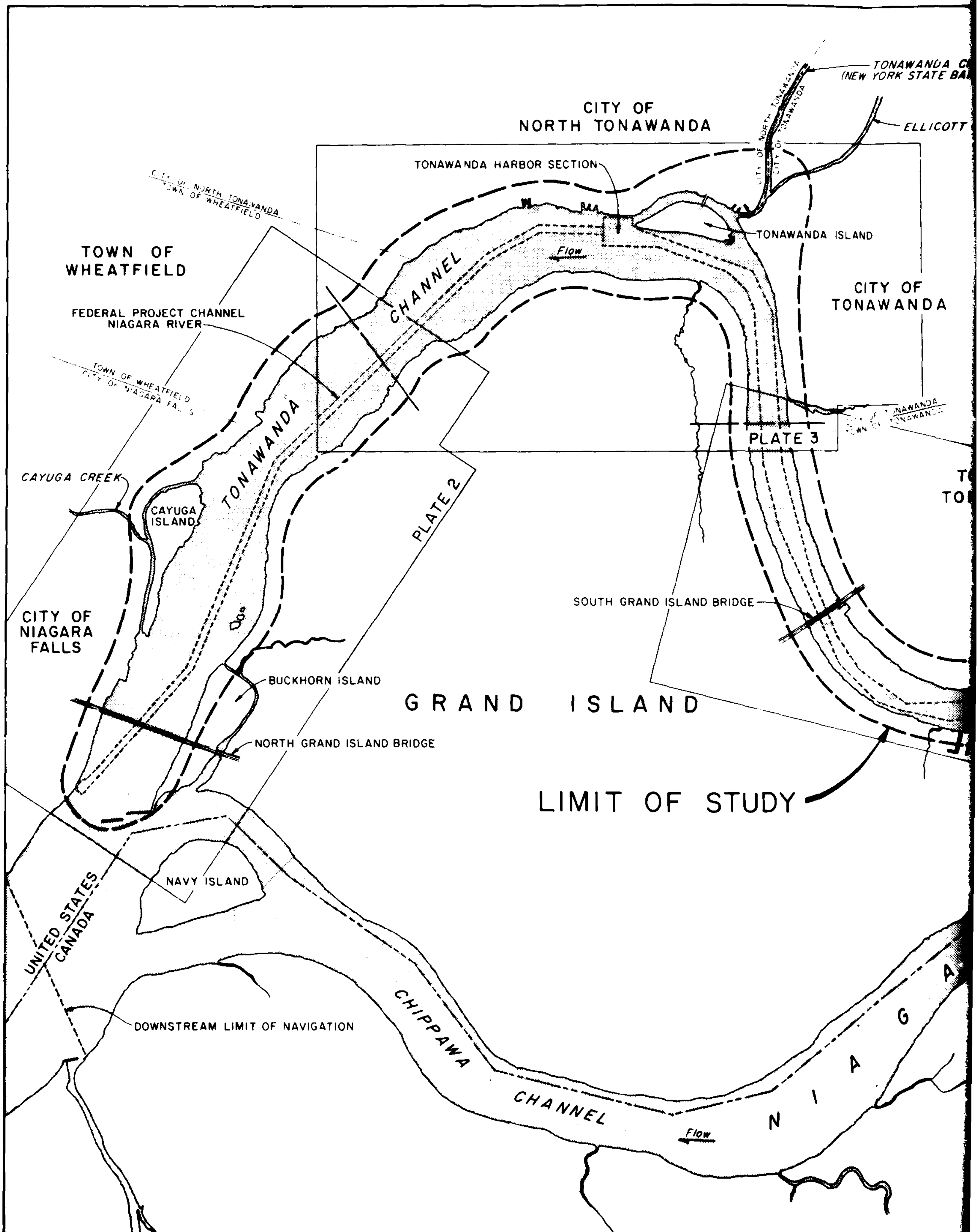
Recommendations will be made to all political subdivisions involved in the study area that they pass and strictly enforce the legislation, building codes and zoning ordinances necessary to ensure similar work will not be required in the future.

SECTION 5
RECOMMENDATIONS

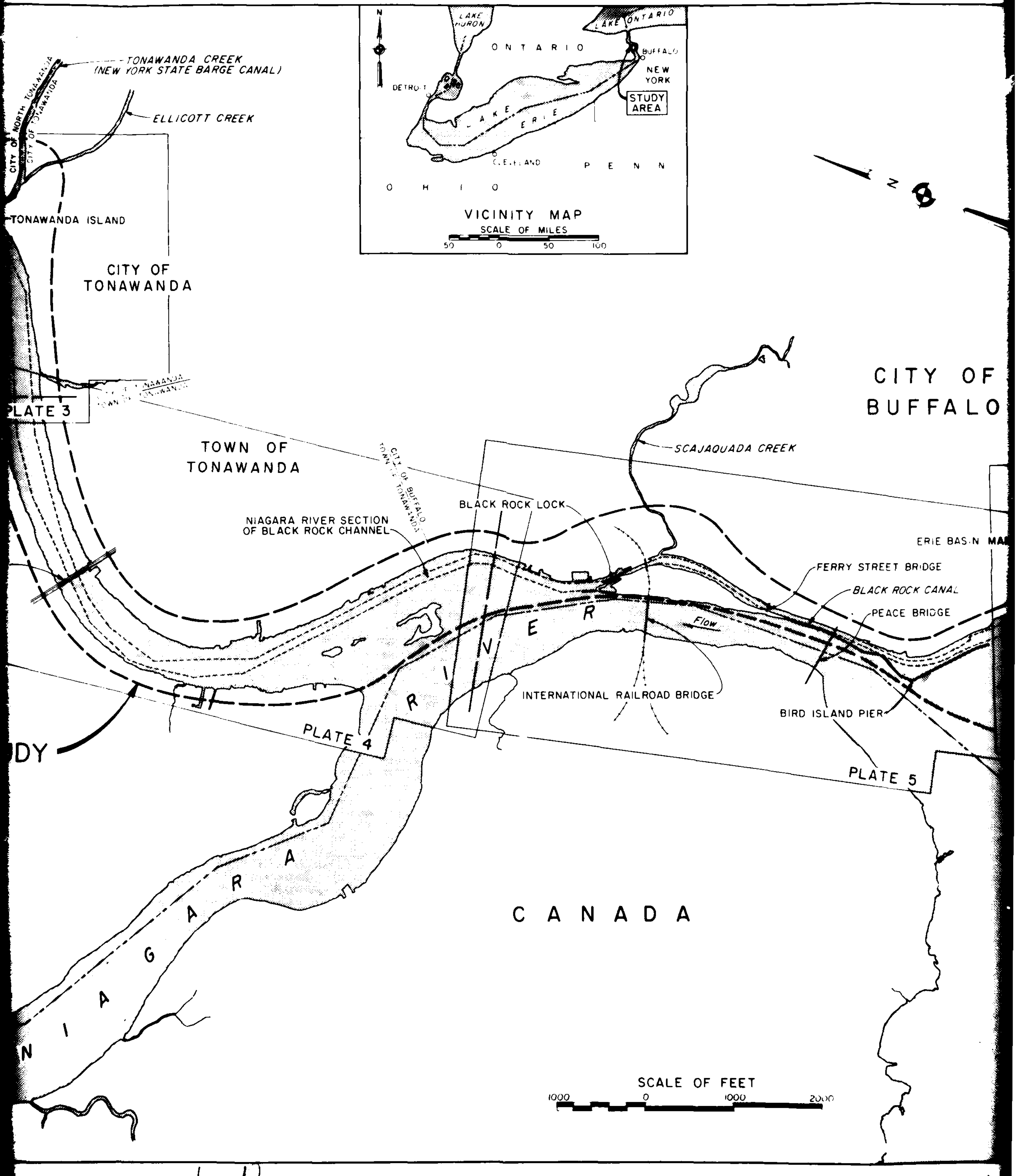
In view of the positive benefit-to-cost ratio, the lack of any significant adverse environmental impacts and the positive impacts on the revitalization of the Buffalo Harbor, it is recommended that the District proceed with Stage 3 investigations of the removal of drift and debris in the study area.

This report, Environmental Assessment, and Finding of No Significant Impact (FONSI) is being coordinated at this time in conjunction with the Buffalo Harbor Study Stage II document to expedite potential implementation of proposed Drift and Debris Removal measures only.

As stated in the Buffalo Harbor Study main report (see Page 102), findings of this and other harbor related studies and/or developments will be considered and any cumulative impacts incorporated into the Final Buffalo Harbor Navigation Improvement Feasibility Study report and Environmental Impact Statement (EIS).



CITY OF NORTH TONAWANDA
TONAWANDA HARBOR SECTION
TONAWANDA ISLAND
CITY OF TONAWANDA
ELLICOTT
TOWN OF WHEATFIELD
CITY OF NORTH TONAWANDA
TOWN OF WHEATFIELD
TOWN OF WHEATFIELD
CITY OF NIAGARA FALLS
FEDERAL PROJECT CHANNEL NIAGARA RIVER
FLOW
TONAWANDA CHANNEL
PLATE 2
PLATE 3
CAYUGA CREEK
CAYUGA ISLAND
CITY OF NIAGARA FALLS
SOUTH GRAND ISLAND BRIDGE
BUCKHORN ISLAND
GRAND ISLAND
NORTH GRAND ISLAND BRIDGE
LIMIT OF STUDY
NAVY ISLAND
UNITED STATES
CANADA
DOWNSTREAM LIMIT OF NAVIGATION
CHIPPAWA CHANNEL
FLOW
NIAGARA


VICINITY MAP
SCALE OF MILES
50 0 50 100
LAKE HURON
LAKE ONTARIO
ONTARIO
BUFFALO
NEW YORK
DETROIT
STUDY AREA
LAKE ERIE
CLEVELAND
PENN
OHIO
TONAWANDA CREEK (NEW YORK STATE BARGE CANAL)
ELLICOTT CREEK
CITY OF NORTH TONAWANDA
CITY OF TONAWANDA
TONAWANDA ISLAND
CITY OF TONAWANDA
PLATE 3
TOWN OF TONAWANDA
CITY OF BUFFALO
TOWN OF TONAWANDA
CITY OF BUFFALO
SCAJAQUADA CREEK
BLACK ROCK LOCK
NIAGARA RIVER SECTION OF BLACK ROCK CHANNEL
ERIE BASIN
FERRY STREET BRIDGE
BLACK ROCK CANAL
PEACE BRIDGE
Flow
INTERNATIONAL RAILROAD BRIDGE
BIRD ISLAND PIER
PLATE 4
PLATE 5
NIAGARA RIVER
CANADA
SCALE OF FEET
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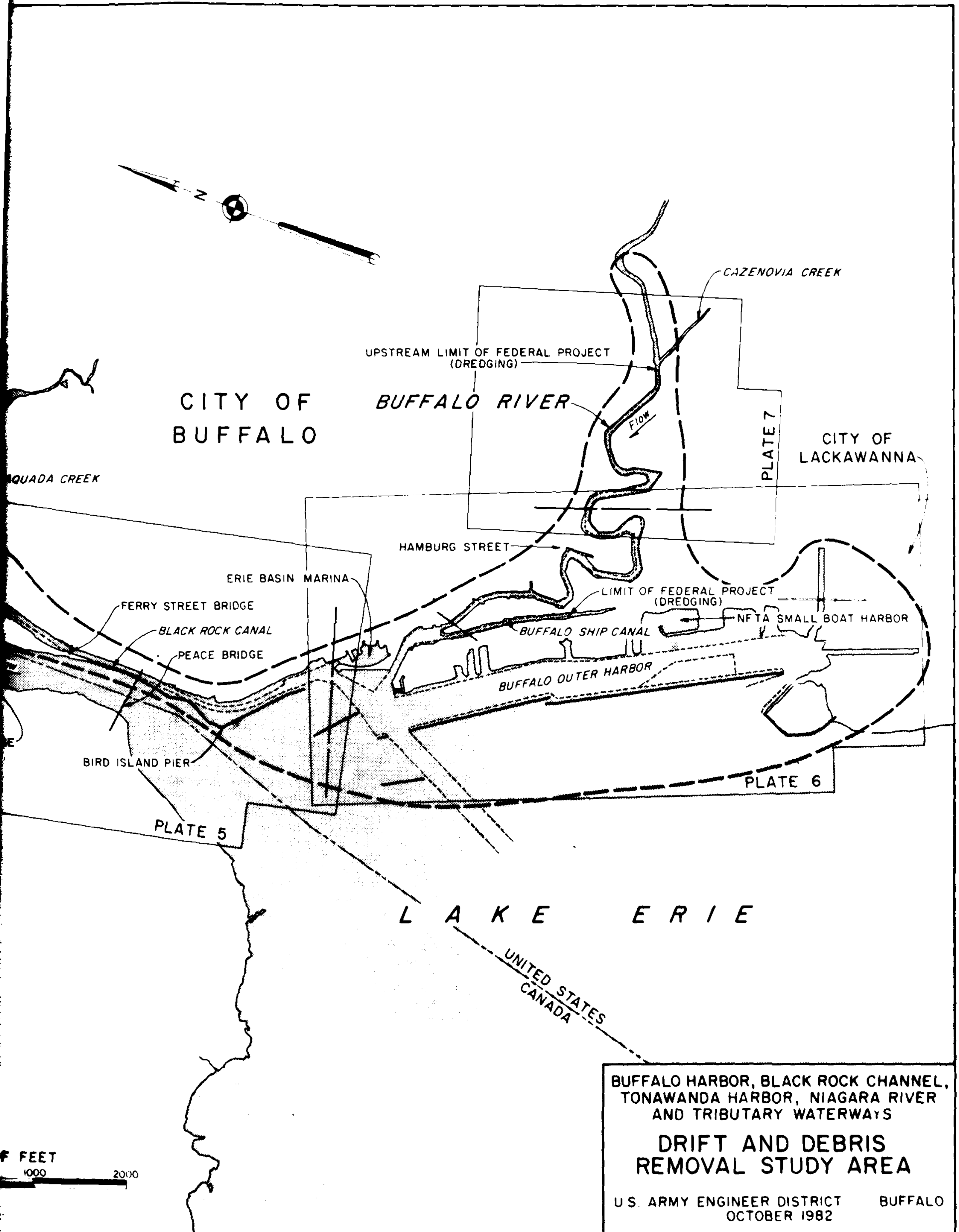
1 12

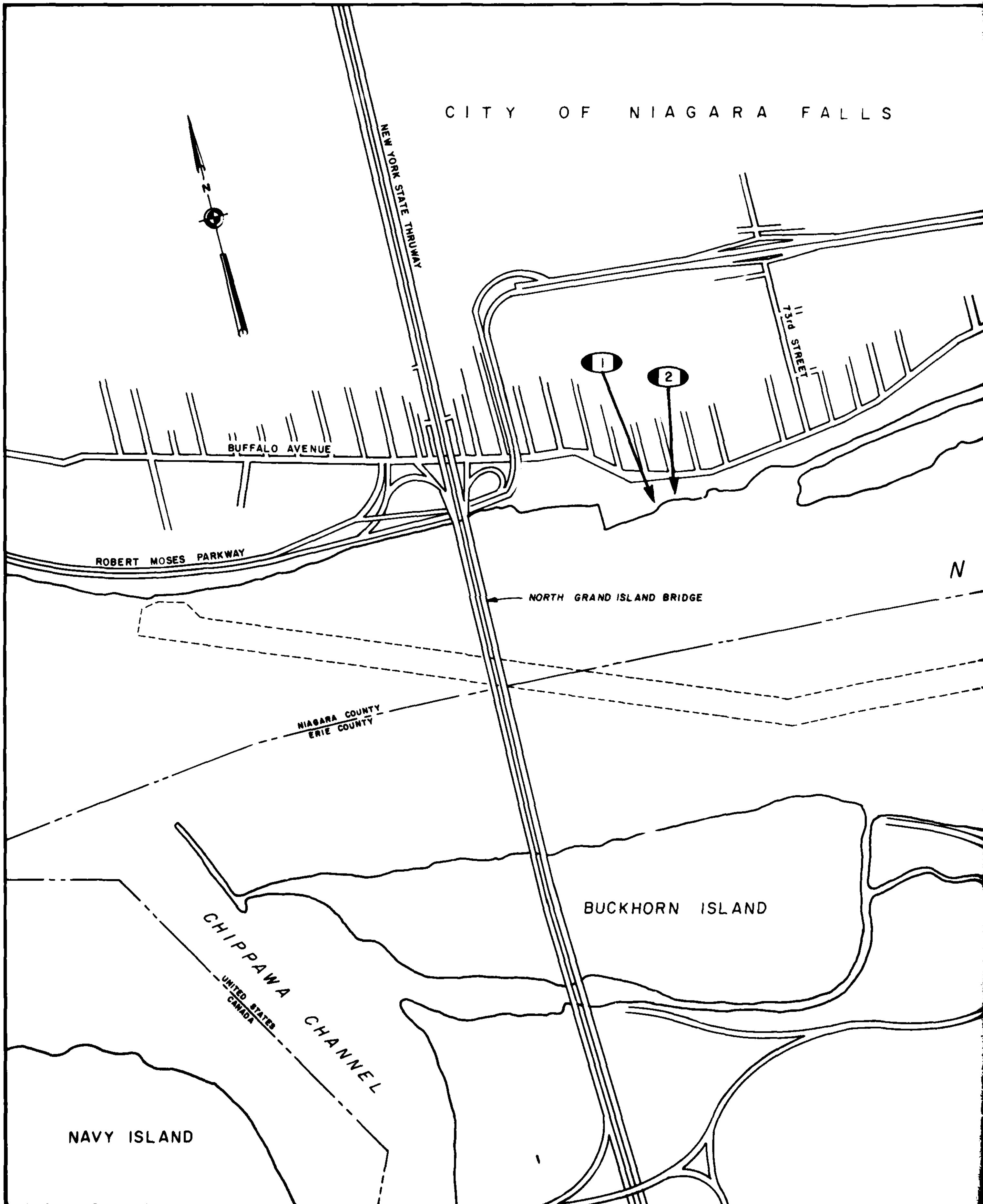


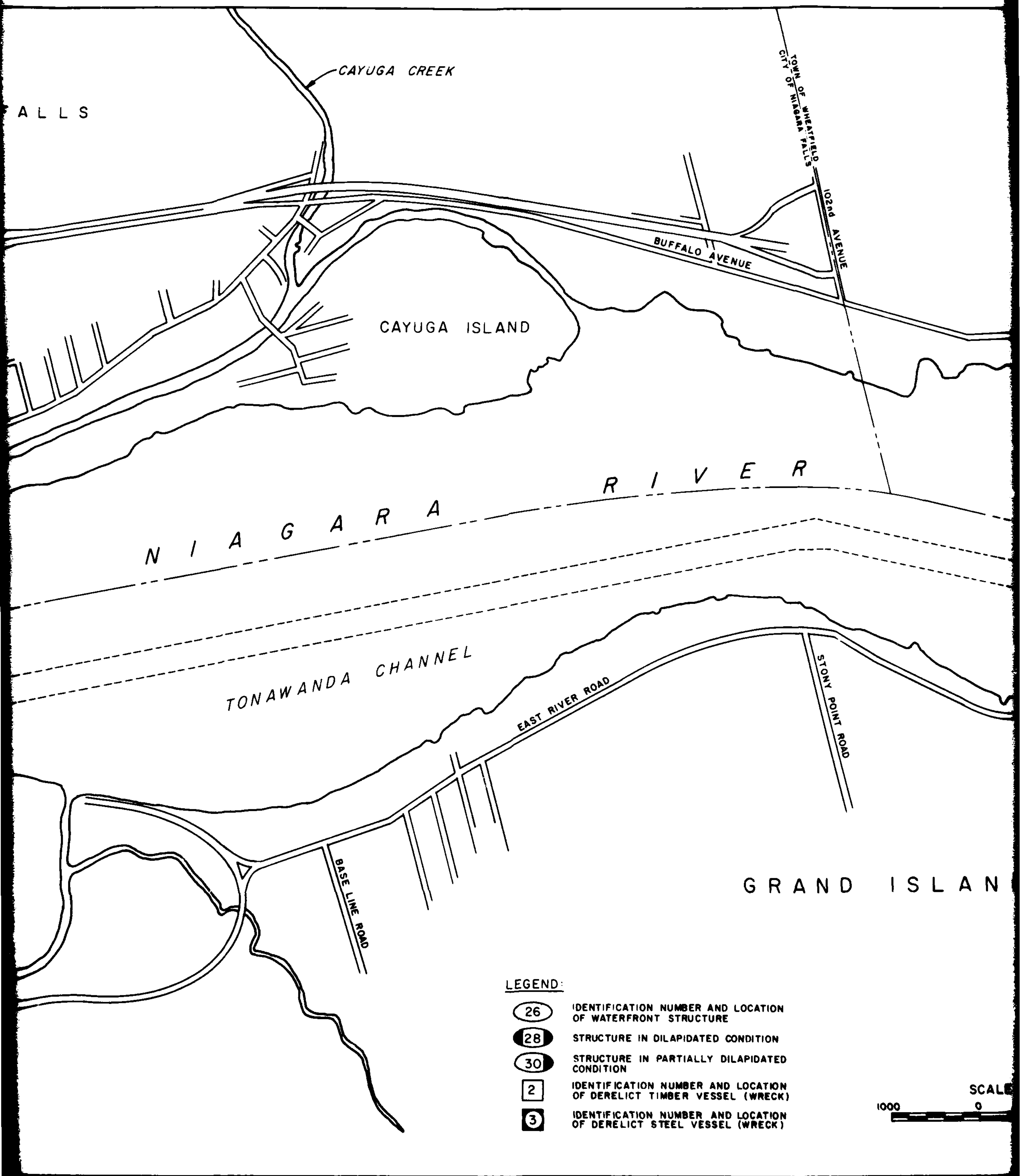
BUFFALO HARBOR, BLACK ROCK CHANNEL, TONAWANDA HARBOR, NIAGARA RIVER AND TRIBUTARY WATERWAYS

DRIFT AND DEBRIS REMOVAL STUDY AREA

U.S. ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE I


CITY OF NIAGARA FALLS
NEW YORK STATE THRUWAY
N
73rd STREET
1
2
BUFFALO AVENUE
ROBERT MOSES PARKWAY
NORTH GRAND ISLAND BRIDGE
N
NIAGARA COUNTY
ERIE COUNTY
BUCKHORN ISLAND
CHIPPAWA CHANNEL
UNITED STATES
CANADA
NAVY ISLAND


ALLS
CAYUGA CREEK
TOWN OF WHEATFIELD
CITY OF NIAGARA FALLS
102nd AVENUE
BUFFALO AVENUE
CAYUGA ISLAND
NIAGARA RIVER
TONAWANDA CHANNEL
EAST RIVER ROAD
STONY POINT ROAD
BASE LINE ROAD
GRAND ISLAN
LEGEND:
26 IDENTIFICATION NUMBER AND LOCATION OF WATERFRONT STRUCTURE
28 STRUCTURE IN DILAPIDATED CONDITION
30 STRUCTURE IN PARTIALLY DILAPIDATED CONDITION
2 IDENTIFICATION NUMBER AND LOCATION OF DERELICT TIMBER VESSEL (WRECK)
3 IDENTIFICATION NUMBER AND LOCATION OF DERELICT STEEL VESSEL (WRECK)
SCALE
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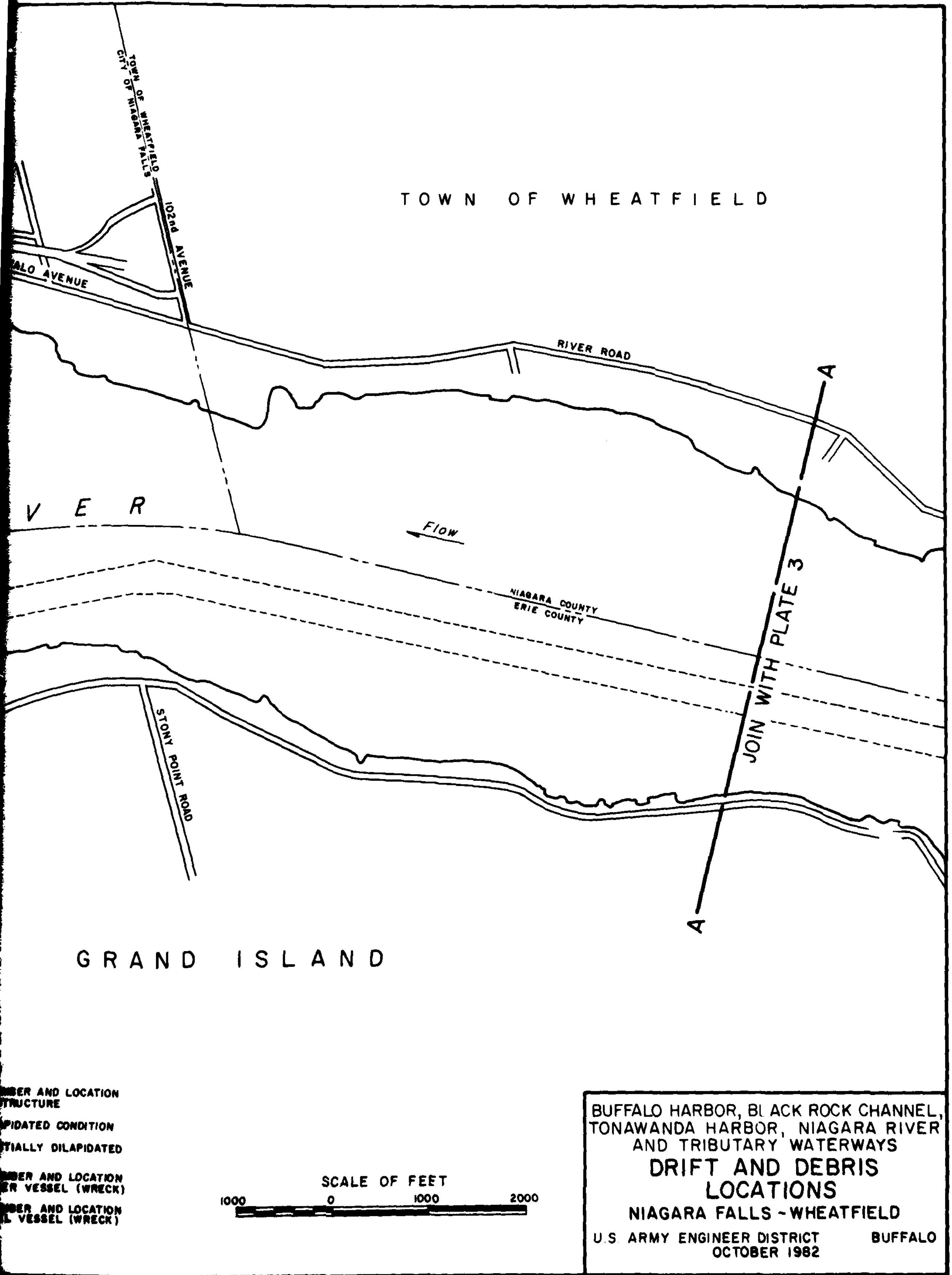
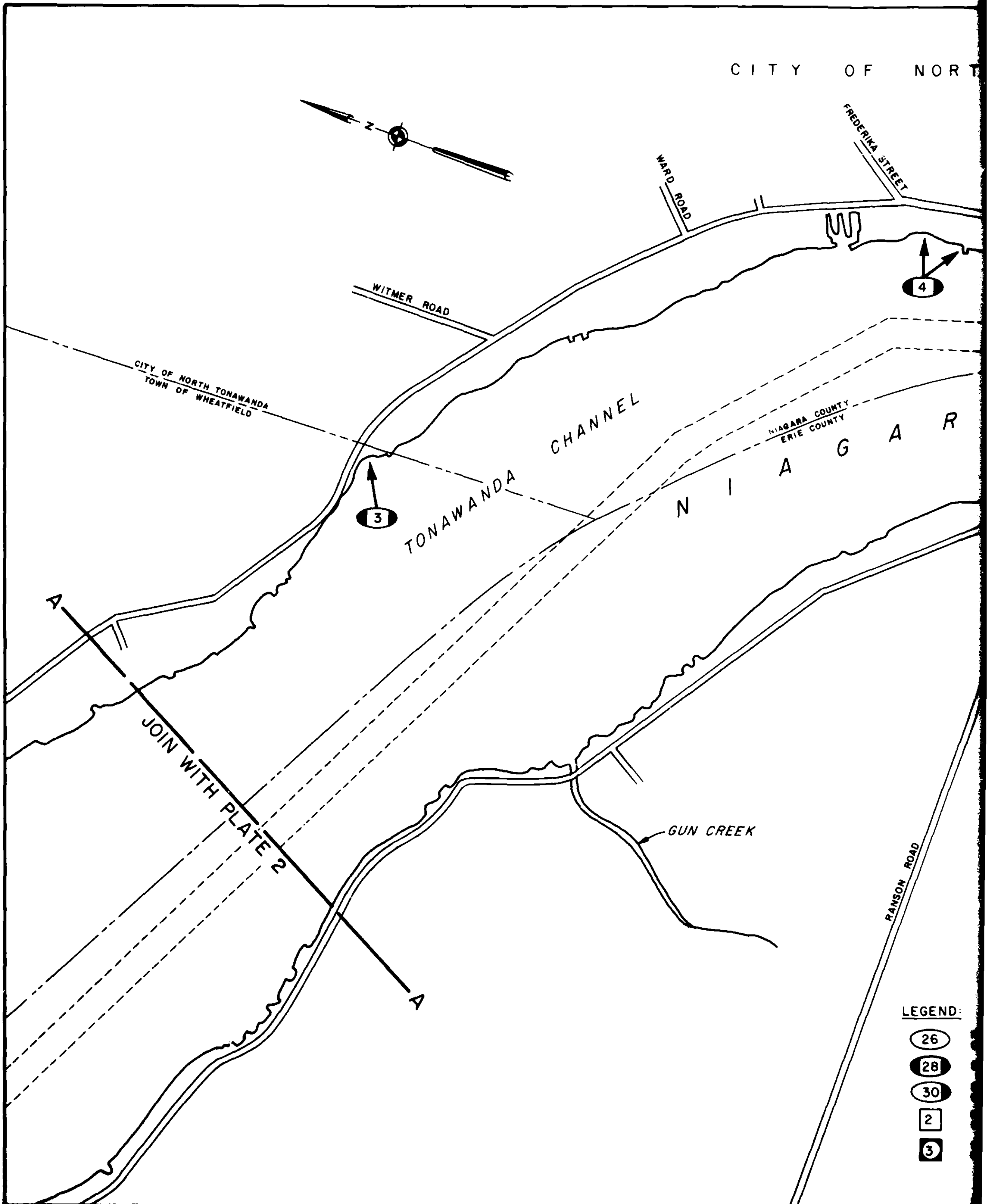


BUFFALO HARBOR, BLACK ROCK CHANNEL,
TONAWANDA HARBOR, NIAGARA RIVER
AND TRIBUTARY WATERWAYS

DRIFT AND DEBRIS LOCATIONS

NIAGARA FALLS - WHEATFIELD

U.S. ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982



CITY OF NORT
N
FREDERIKA STREET
WARD ROAD
WITMER ROAD
CITY OF NORTH TONAWANDA
TOWN OF WHEATFIELD
TONAWANDA CHANNEL
NIAGARA COUNTY
ERIE COUNTY
N I A G A R
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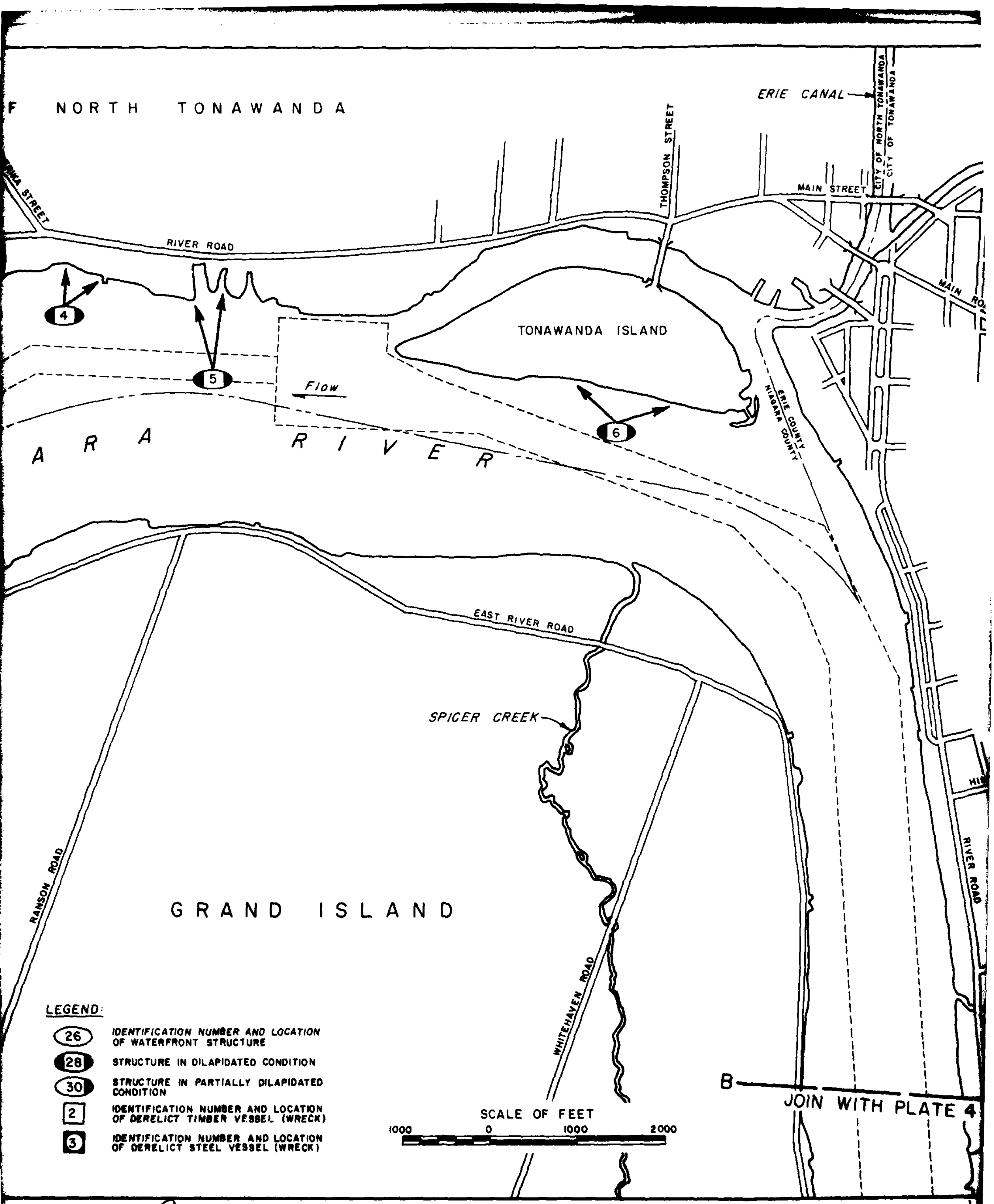
4
A
JOIN WITH PLATE 2
A
GUN CREEK
RANSON ROAD
LEGEND:
26
28
30
2
3



F NORTH TONAWANDA
ERIE CANAL
CITY OF NORTH TONAWANDA
CITY OF TONAWANDA
THOMPSON STREET
MAIN STREET
RIVER ROAD
MAIN RO
TONAWANDA ISLAND
4
5
6
Flow
ERIE COUNTY
NIAGARA COUNTY
ARA RIVER
EAST RIVER ROAD
SPICER CREEK
RANSON ROAD
GRAND ISLAND
WHITEHAVEN ROAD
RIVER ROAD
LEGEND:
26 IDENTIFICATION NUMBER AND LOCATION OF WATERFRONT STRUCTURE
28 STRUCTURE IN DILAPIDATED CONDITION
30 STRUCTURE IN PARTIALLY DILAPIDATED CONDITION
2 IDENTIFICATION NUMBER AND LOCATION OF DERELICT TIMBER VESSEL (WRECK)
3 IDENTIFICATION NUMBER AND LOCATION OF DERELICT STEEL VESSEL (WRECK)
SCALE OF FEET
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JOIN WITH PLATE 4

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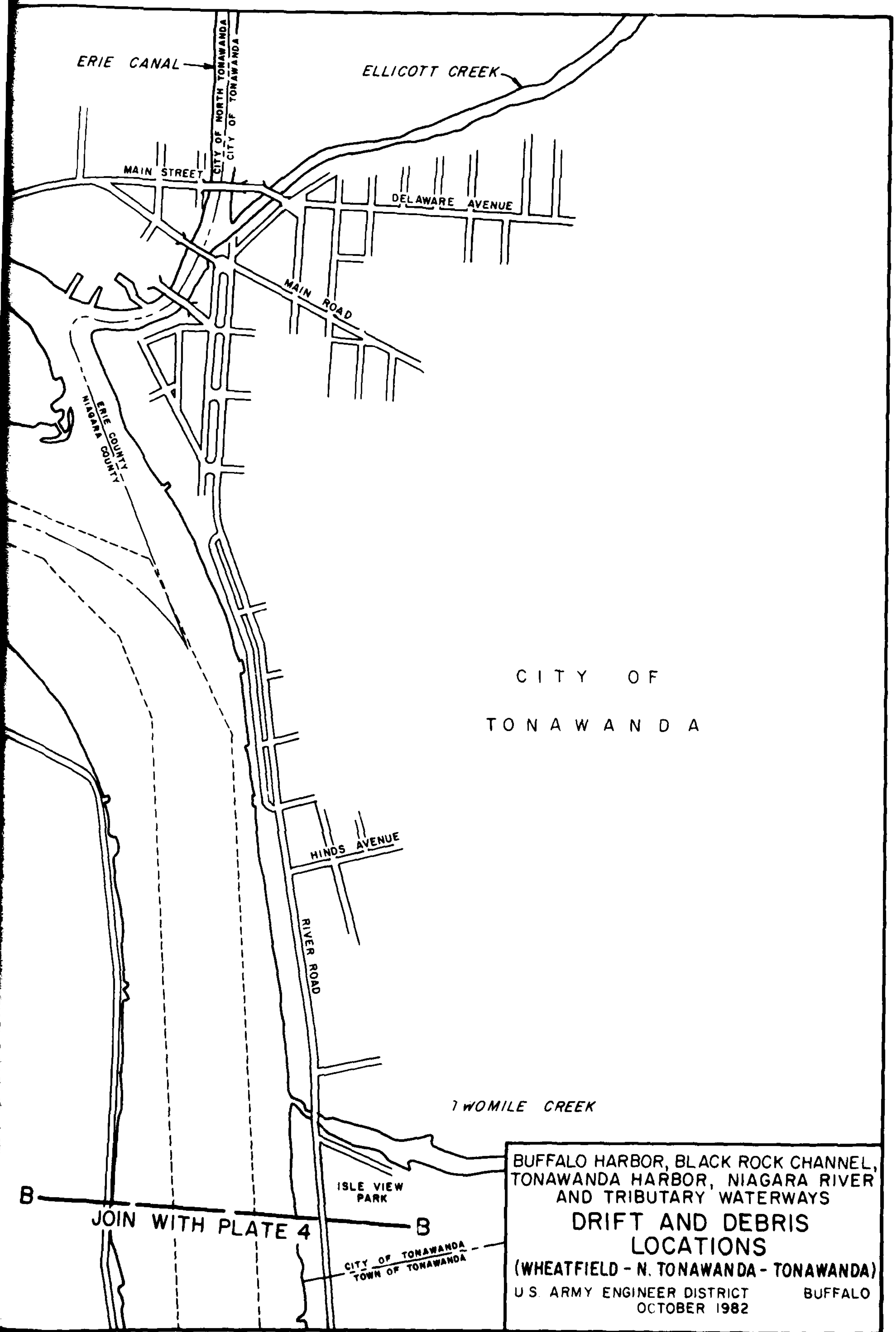


BUFFALO HARBOR, BLACK ROCK CHANNEL, TONAWANDA HARBOR, NIAGARA RIVER AND TRIBUTARY WATERWAYS

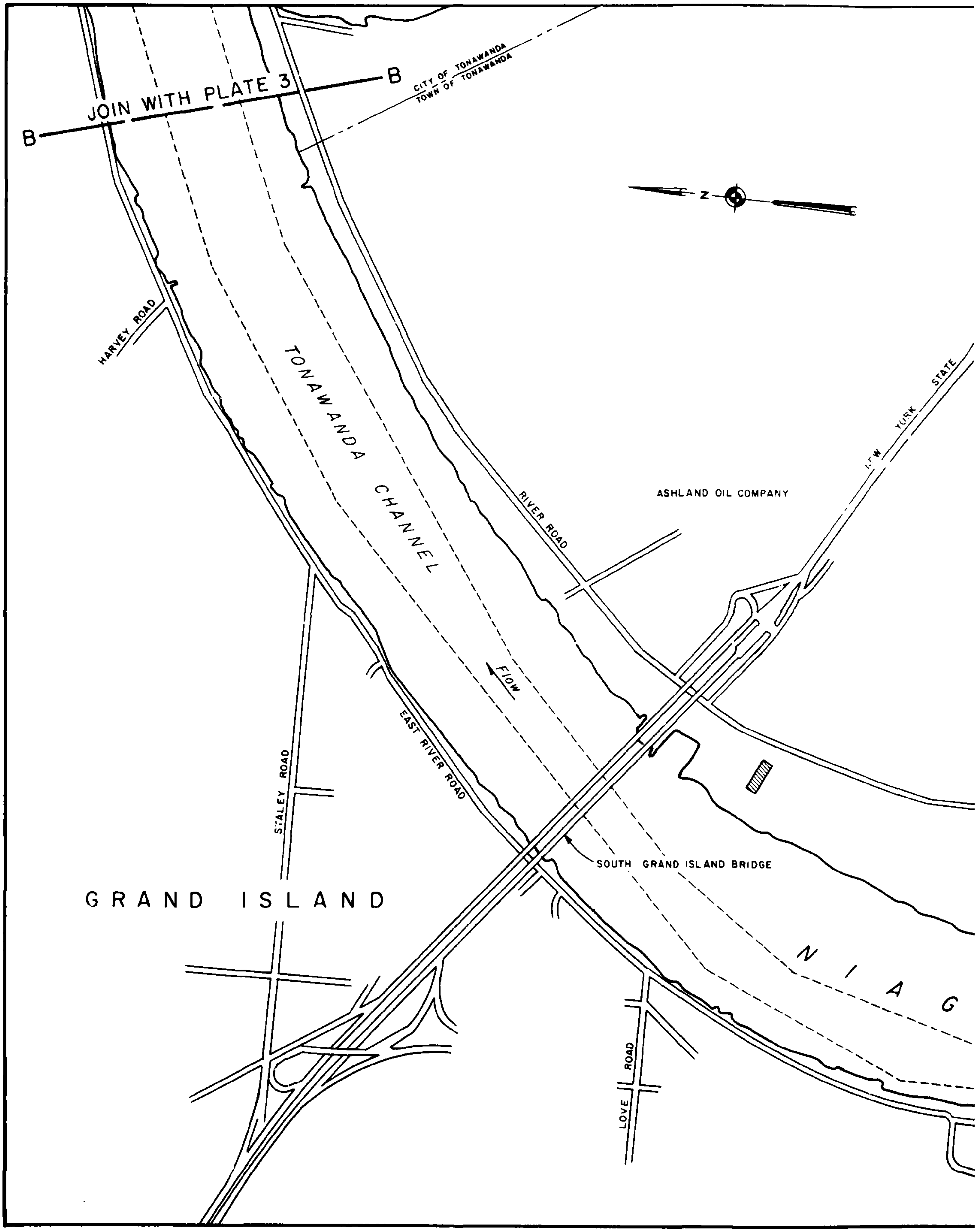
DRIFT AND DEBRIS LOCATIONS

(WHEATFIELD - N. TONAWANDA - TONAWANDA)

U.S. ARMY ENGINEER DISTRICT BUFFALO

OCTOBER 1982

PLATE 3


JOIN WITH PLATE 3
B
B
CITY OF TONAWANDA
TOWN OF TONAWANDA
N
HARVEY ROAD
TONAWANDA CHANNEL
RIVER ROAD
ASHLAND OIL COMPANY
STATE
YORK
FLOW
EAST RIVER ROAD
STALEY ROAD
SOUTH GRAND ISLAND BRIDGE
GRAND ISLAND
N I A G
LOVE ROAD

AD-A129 189 BUFFALO HARBOR STUDY PRELIMINARY FEASIBILITY REPORT 6/8
VOLUME II APPENDICES(U) CORPS OF ENGINEERS BUFFALO NY
BUFFALO DISTRICT APR 83

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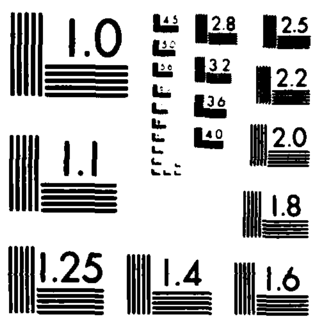
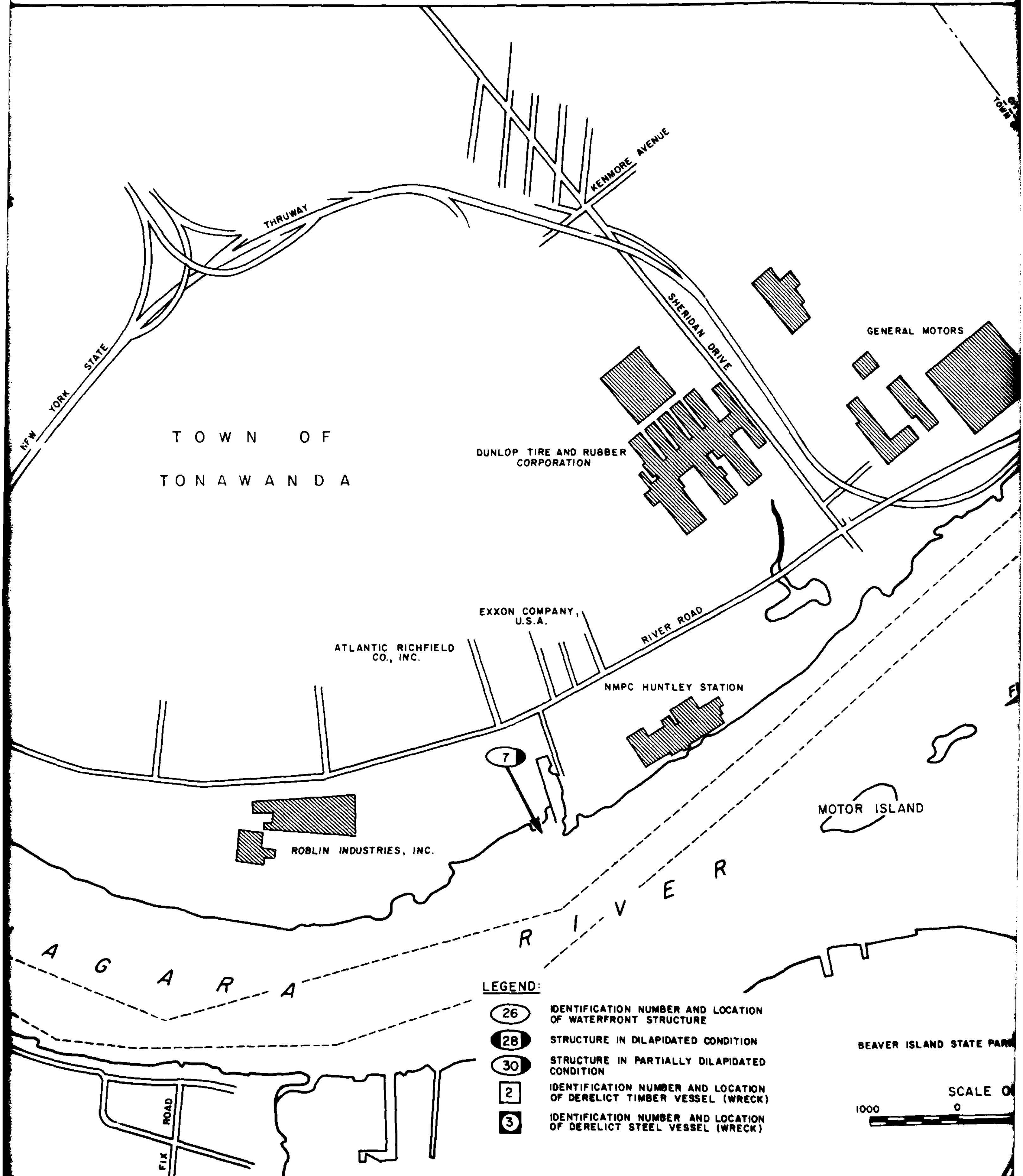


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A



KENMORE AVENUE
THRUWAY
NEW YORK STATE
SHERIDAN DRIVE
GENERAL MOTORS
TOWN OF TONAWANDA
DUNLOP TIRE AND RUBBER CORPORATION
EXXON COMPANY, U.S.A.
ATLANTIC RICHFIELD CO., INC.
RIVER ROAD
NMPC HUNTLEY STATION
7
MOTOR ISLAND
ROBLIN INDUSTRIES, INC.
AGARA RIVER
LEGEND:
26 IDENTIFICATION NUMBER AND LOCATION OF WATERFRONT STRUCTURE
28 STRUCTURE IN DILAPIDATED CONDITION
30 STRUCTURE IN PARTIALLY DILAPIDATED CONDITION
2 IDENTIFICATION NUMBER AND LOCATION OF DERELICT TIMBER VESSEL (WRECK)
3 IDENTIFICATION NUMBER AND LOCATION OF DERELICT STEEL VESSEL (WRECK)
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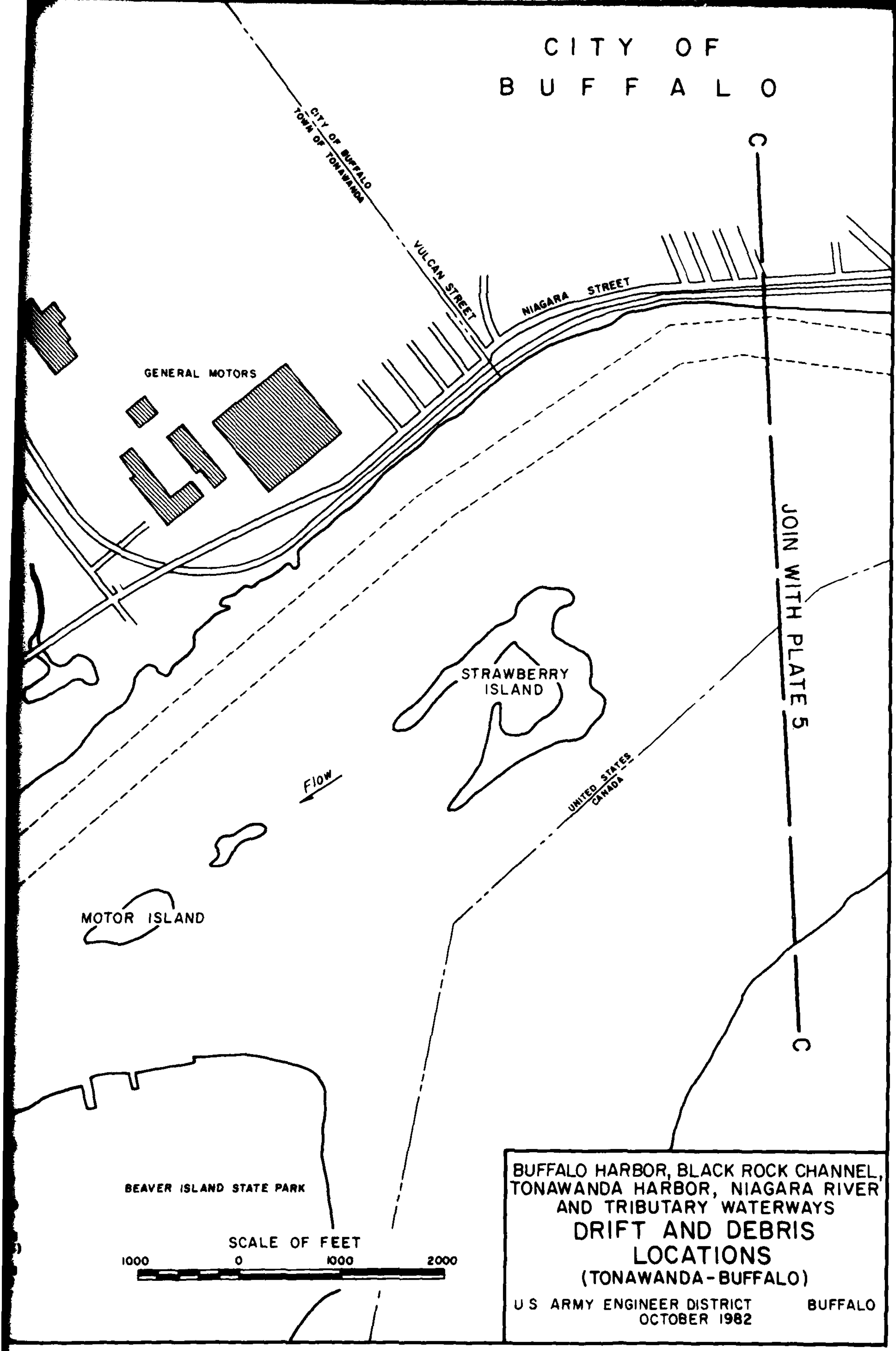


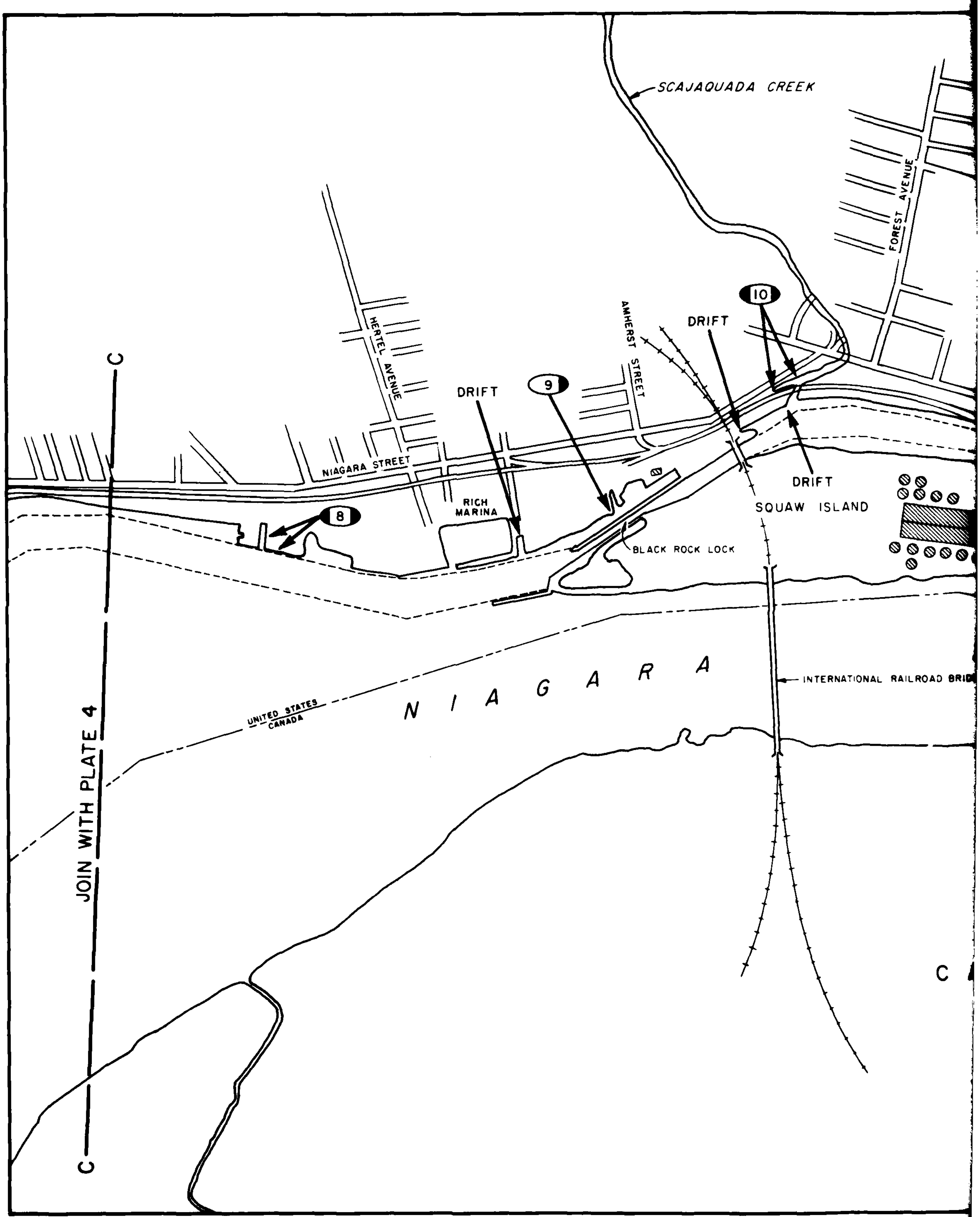
BUFFALO HARBOR, BLACK ROCK CHANNEL, TONAWANDA HARBOR, NIAGARA RIVER AND TRIBUTARY WATERWAYS

DRIFT AND DEBRIS LOCATIONS

(TONAWANDA - BUFFALO)

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

1 2


SCAJAQUADA CREEK
FOREST AVENUE
HERTEL AVENUE
AMHERST STREET
NIAGARA STREET
DRIFT
DRIFT
DRIFT
9
10
8
RICH MARINA
BLACK ROCK LOCK
SQUAW ISLAND
INTERNATIONAL RAILROAD BRID
N I A G A R A
UNITED STATES
CANADA
JOIN WITH PLATE 4
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C
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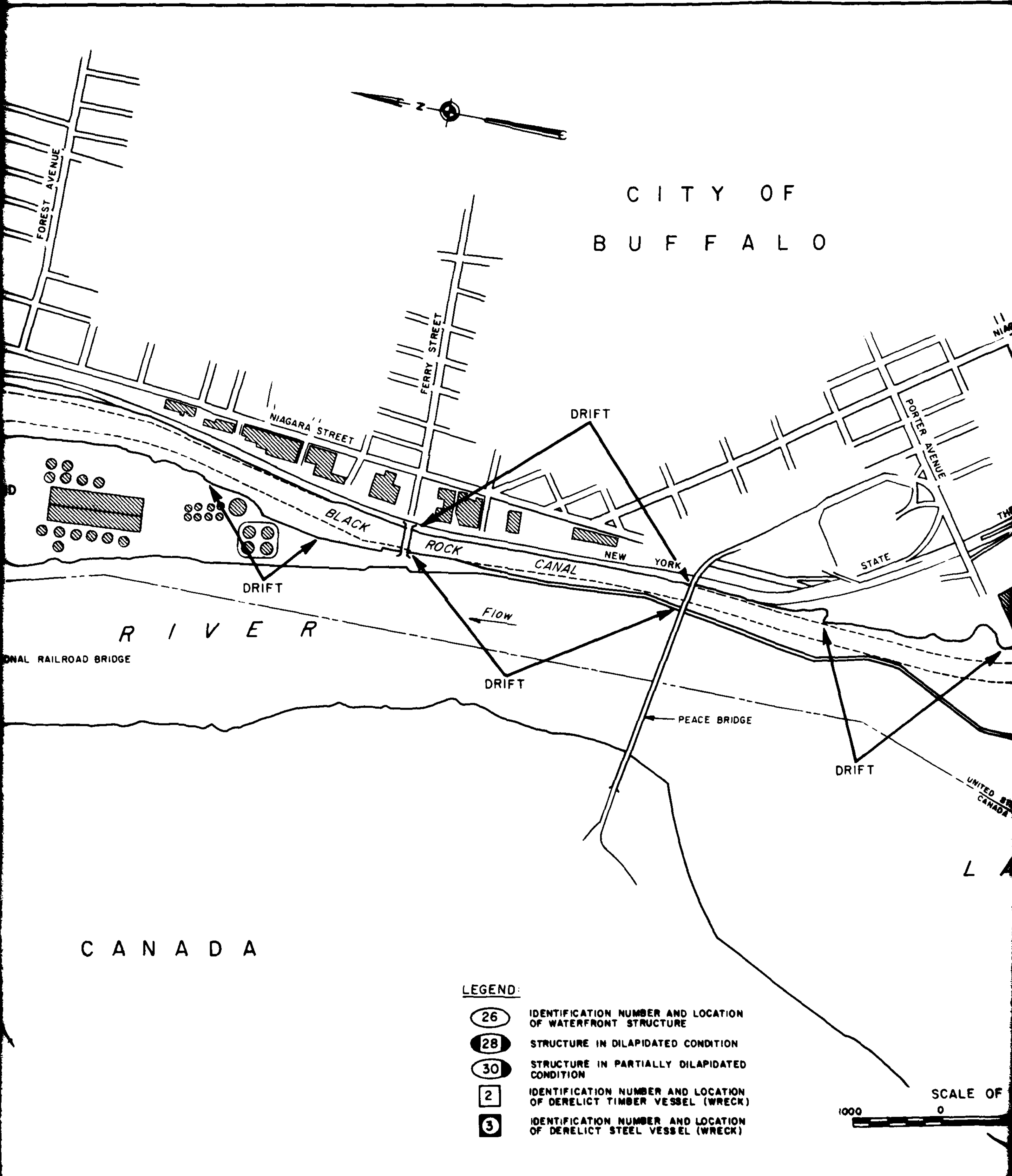
CITY OF BUFFALO
FOREST AVENUE
FERRY STREET
NIAGARA STREET
PORTER AVENUE
DRIFT
DRIFT
DRIFT
DRIFT
BLACK ROCK CANAL
NEW YORK
STATE
FLOW
RIVER
NAL RAILROAD BRIDGE
PEACE BRIDGE
UNITED
CANADA
CANADA
LEGEND:
26 IDENTIFICATION NUMBER AND LOCATION OF WATERFRONT STRUCTURE
28 STRUCTURE IN DILAPIDATED CONDITION
30 STRUCTURE IN PARTIALLY DILAPIDATED CONDITION
2 IDENTIFICATION NUMBER AND LOCATION OF DERELICT TIMBER VESSEL (WRECK)
3 IDENTIFICATION NUMBER AND LOCATION OF DERELICT STEEL VESSEL (WRECK)
SCALE OF
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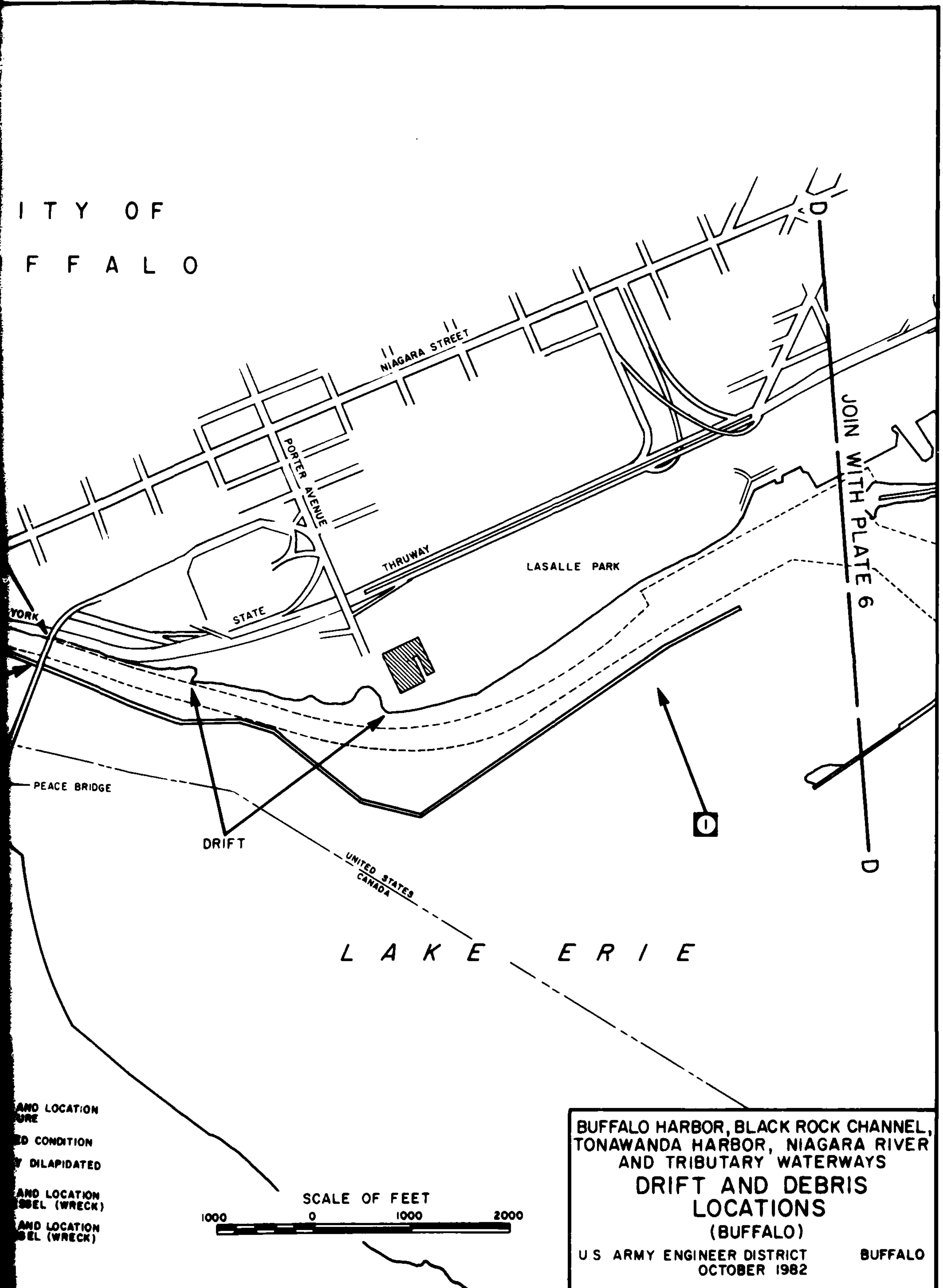


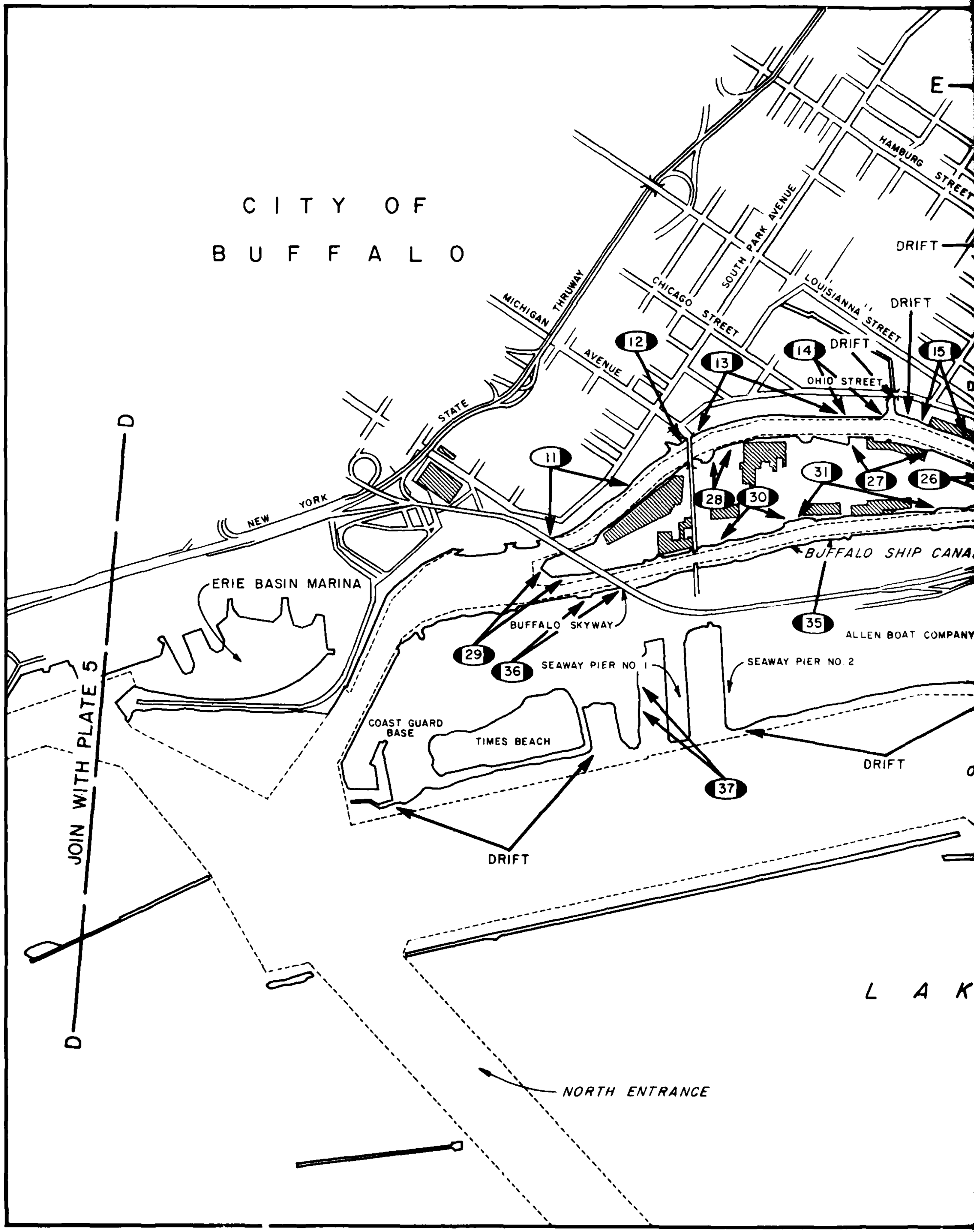
BUFFALO HARBOR, BLACK ROCK CHANNEL, TONAWANDA HARBOR, NIAGARA RIVER AND TRIBUTARY WATERWAYS

DRIFT AND DEBRIS LOCATIONS

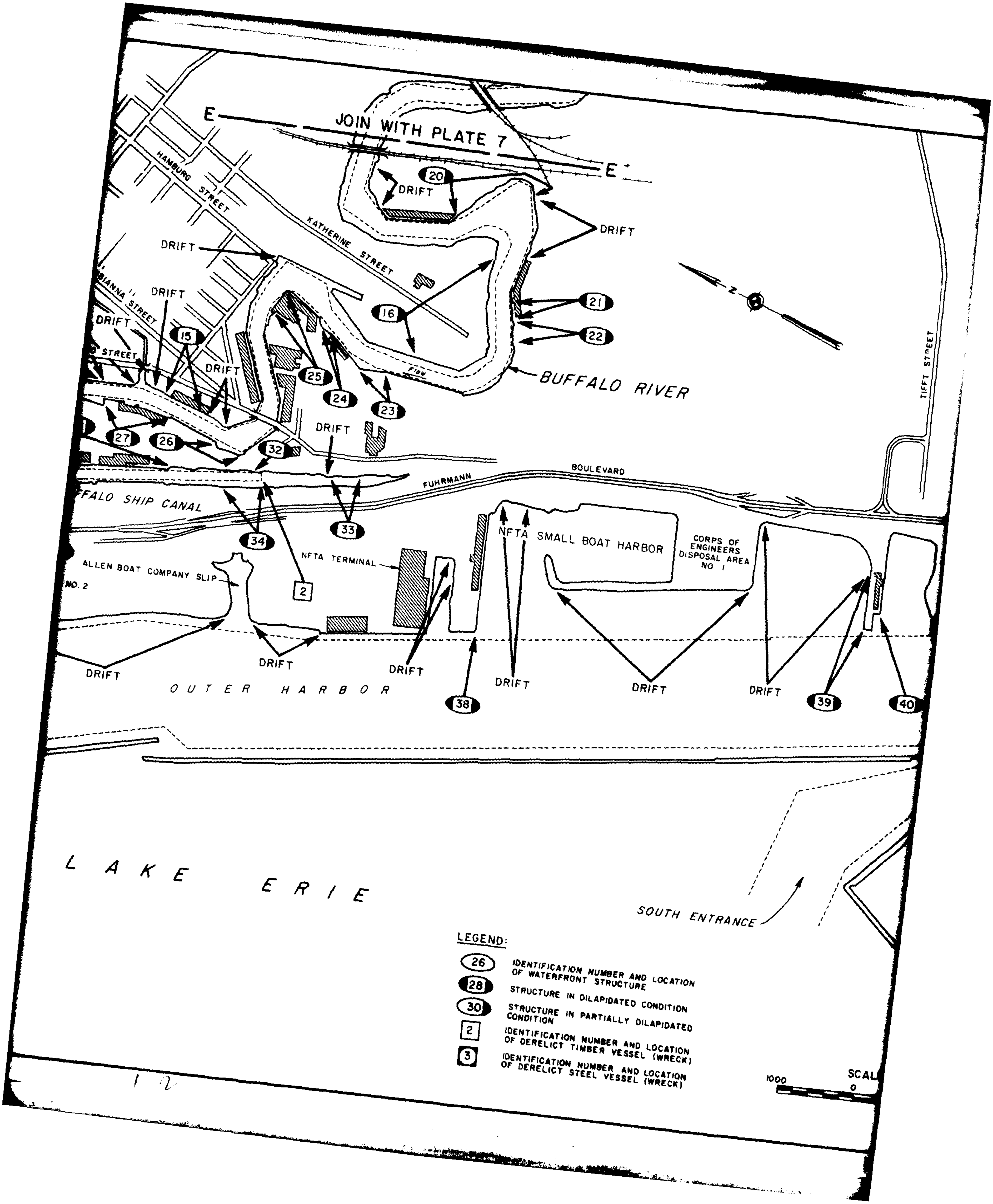
(BUFFALO)

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE 5



CITY OF BUFFALO
E
HAMBURG STREET
DRIFT
SOUTH PARK AVENUE
CHICAGO STREET
LOUISIANNA STREET
DRIFT
MICHIGAN AVENUE
THRUWAY
12
13
14
DRIFT
15
OHIO STREET
STATE
D
11
31
27
26
28
30
NEW YORK
BUFFALO SHIP CANAL
ERIE BASIN MARINA
35
ALLEN BOAT COMPANY
BUFFALO SKYWAY
29
36
SEAWAY PIER NO. 1
SEAWAY PIER NO. 2
JOIN WITH PLATE 5
COAST GUARD BASE
TIMES BEACH
DRIFT
37
DRIFT
LAK
D
NORTH ENTRANCE



JOIN WITH PLATE 7
E
E
HAMBURG STREET
KATHERINE STREET
BUFFALO RIVER
Flow
TIFFT STREET
DRIFT
20
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21
22
15
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24
23
27
26
32
33
34
2
38
39
40
BOULEVARD
FUHRMANN
FFALO SHIP CANAL
NFTA TERMINAL
ALLEN BOAT COMPANY SLIP
NO. 2
NFTA SMALL BOAT HARBOR
CORPS OF ENGINEERS DISPOSAL AREA NO 1
OUTER HARBOR
LAKE ERIE
SOUTH ENTRANCE
LEGEND:
26 IDENTIFICATION NUMBER AND LOCATION OF WATERFRONT STRUCTURE
28 STRUCTURE IN DILAPIDATED CONDITION
30 STRUCTURE IN PARTIALLY DILAPIDATED CONDITION
2 IDENTIFICATION NUMBER AND LOCATION OF DERELICT TIMBER VESSEL (WRECK)
3 IDENTIFICATION NUMBER AND LOCATION OF DERELICT STEEL VESSEL (WRECK)
SCAL
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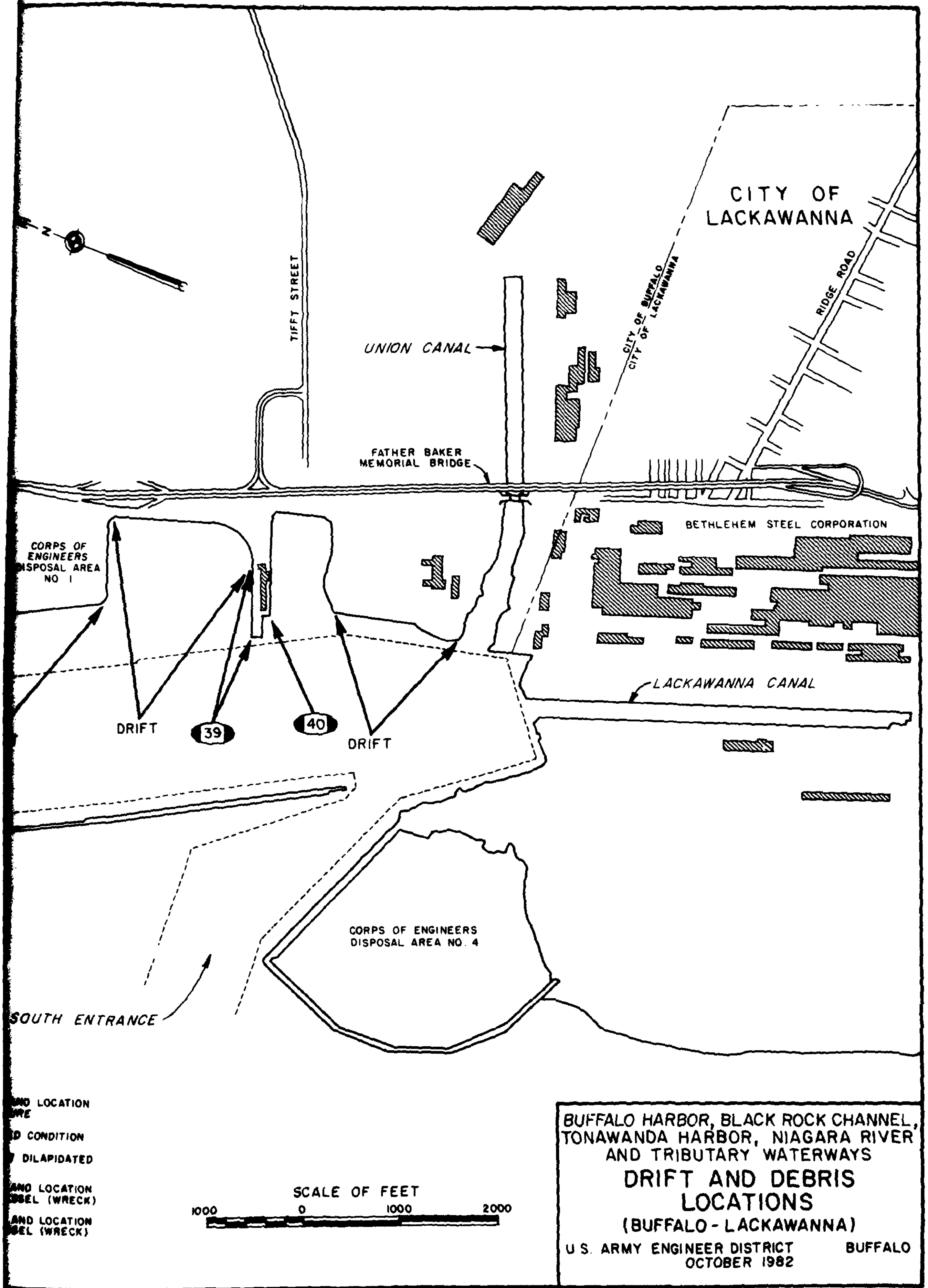


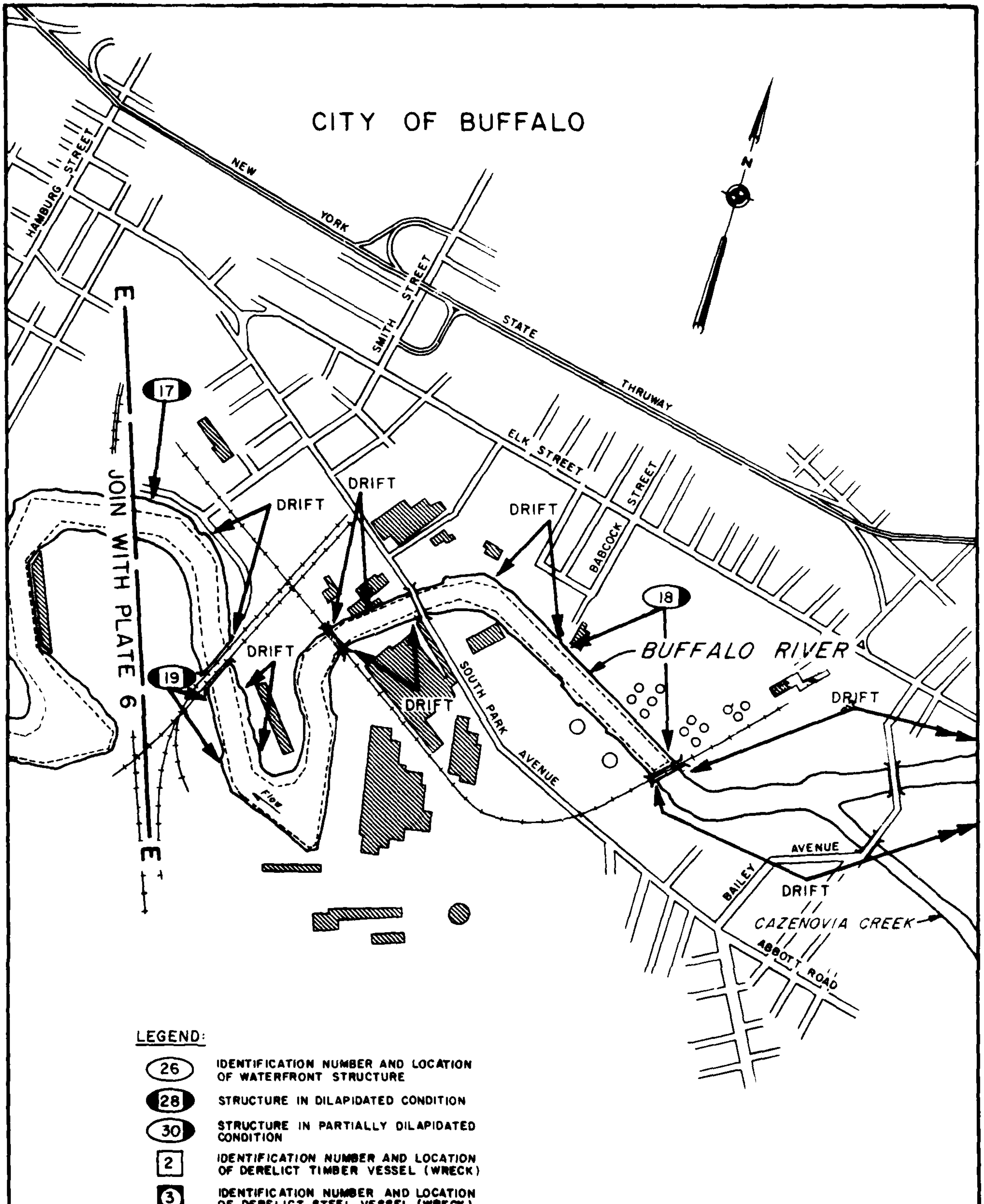
BUFFALO HARBOR, BLACK ROCK CHANNEL, TONAWANDA HARBOR, NIAGARA RIVER AND TRIBUTARY WATERWAYS

DRIFT AND DEBRIS LOCATIONS

(BUFFALO - LACKAWANNA)

U.S. ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE 6

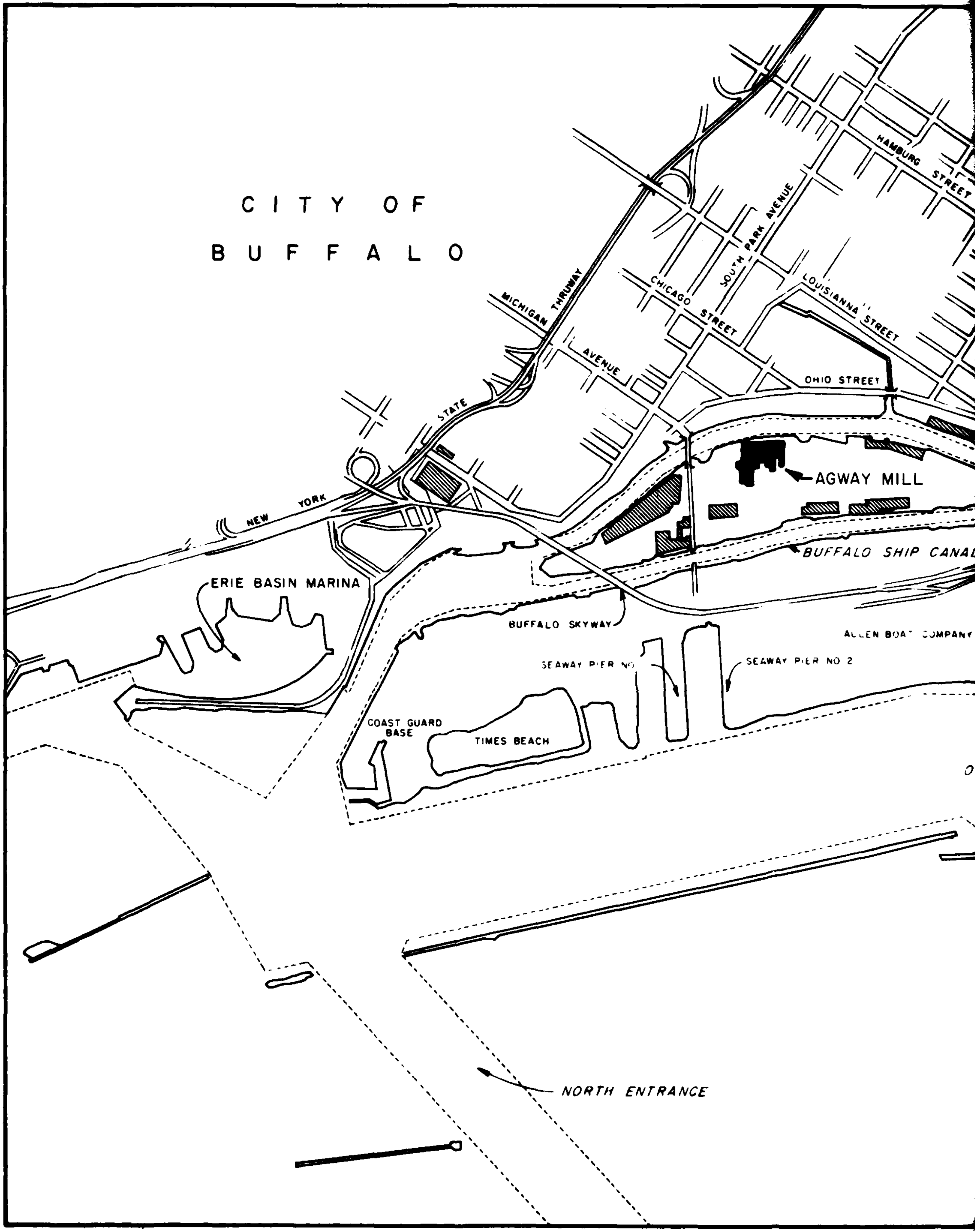


BUFFALO HARBOR, BLACK ROCK CHANNEL, TONAWANDA HARBOR, NIAGARA RIVER AND TRIBUTARY WATERWAYS

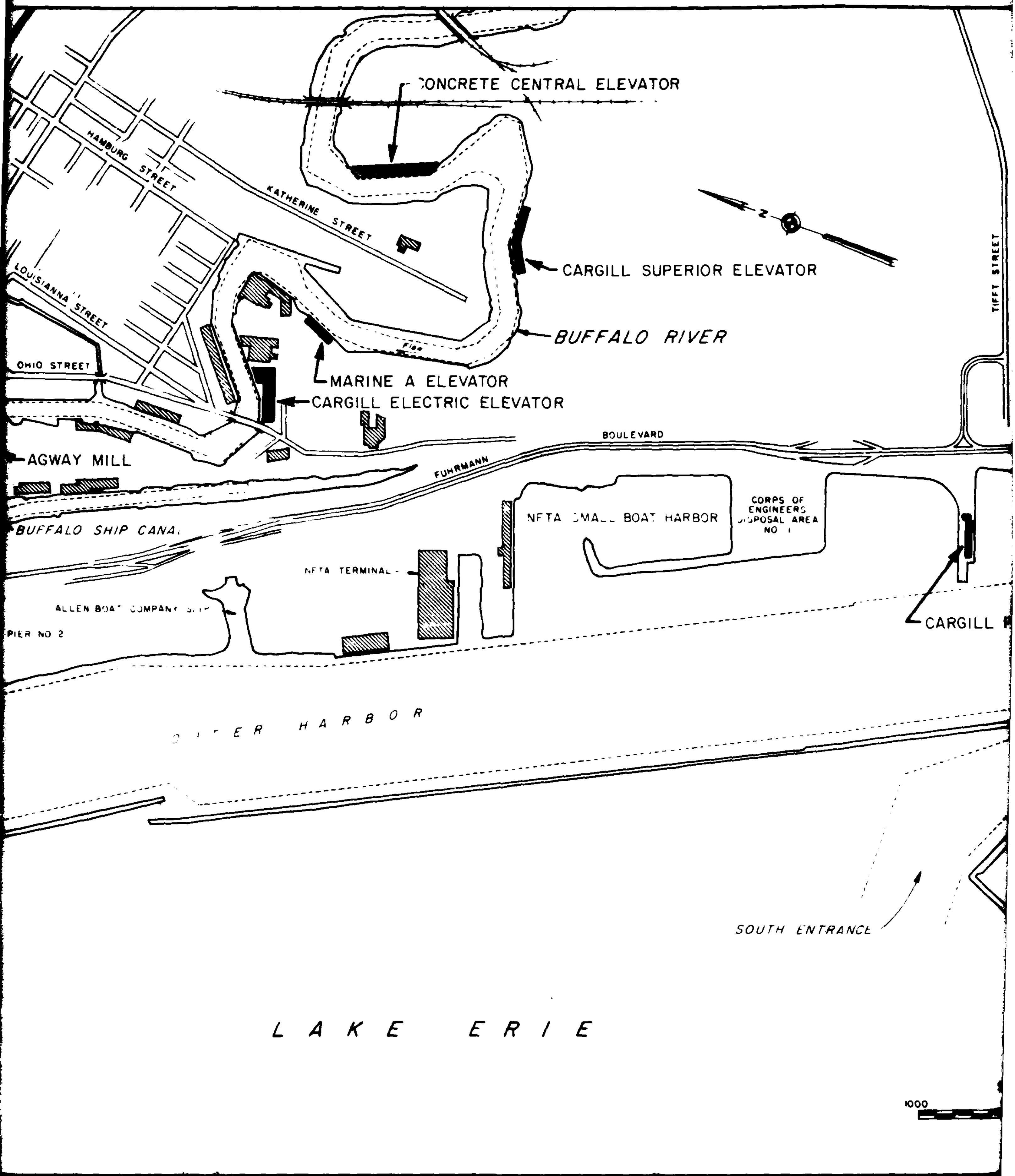
DRIFT AND DEBRIS LOCATIONS

(BUFFALO)

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982



CITY OF BUFFALO
MICHIGAN
THRUWAY
HAMBURG STREET
SOUTH PARK AVENUE
CHICAGO STREET
LOUISIANNA STREET
AVENUE
STATE
OHIO STREET
NEW YORK
AGWAY MILL
BUFFALO SHIP CANAL
ERIE BASIN MARINA
BUFFALO SKYWAY
ALLEN BOAT COMPANY
SEAWAY PIER NO
SEAWAY PIER NO 2
COAST GUARD BASE
TIMES BEACH
NORTH ENTRANCE


CONCRETE CENTRAL ELEVATOR
HAMBURG STREET
KATHERINE STREET
CARGILL SUPERIOR ELEVATOR
TIFFT STREET
LOUISIANNA STREET
BUFFALO RIVER
OHIO STREET
MARINE A ELEVATOR
CARGILL ELECTRIC ELEVATOR
BOULEVARD
AGWAY MILL
FUHRMANN
CORPS OF ENGINEERS DISPOSAL AREA NO 1
NFTA SMALL BOAT HARBOR
BUFFALO SHIP CANAL
NFTA TERMINAL
ALLEN BOAT COMPANY SLIP
PIER NO 2
CARGILL
HARBOR
SOUTH ENTRANCE
LAKE ERIE
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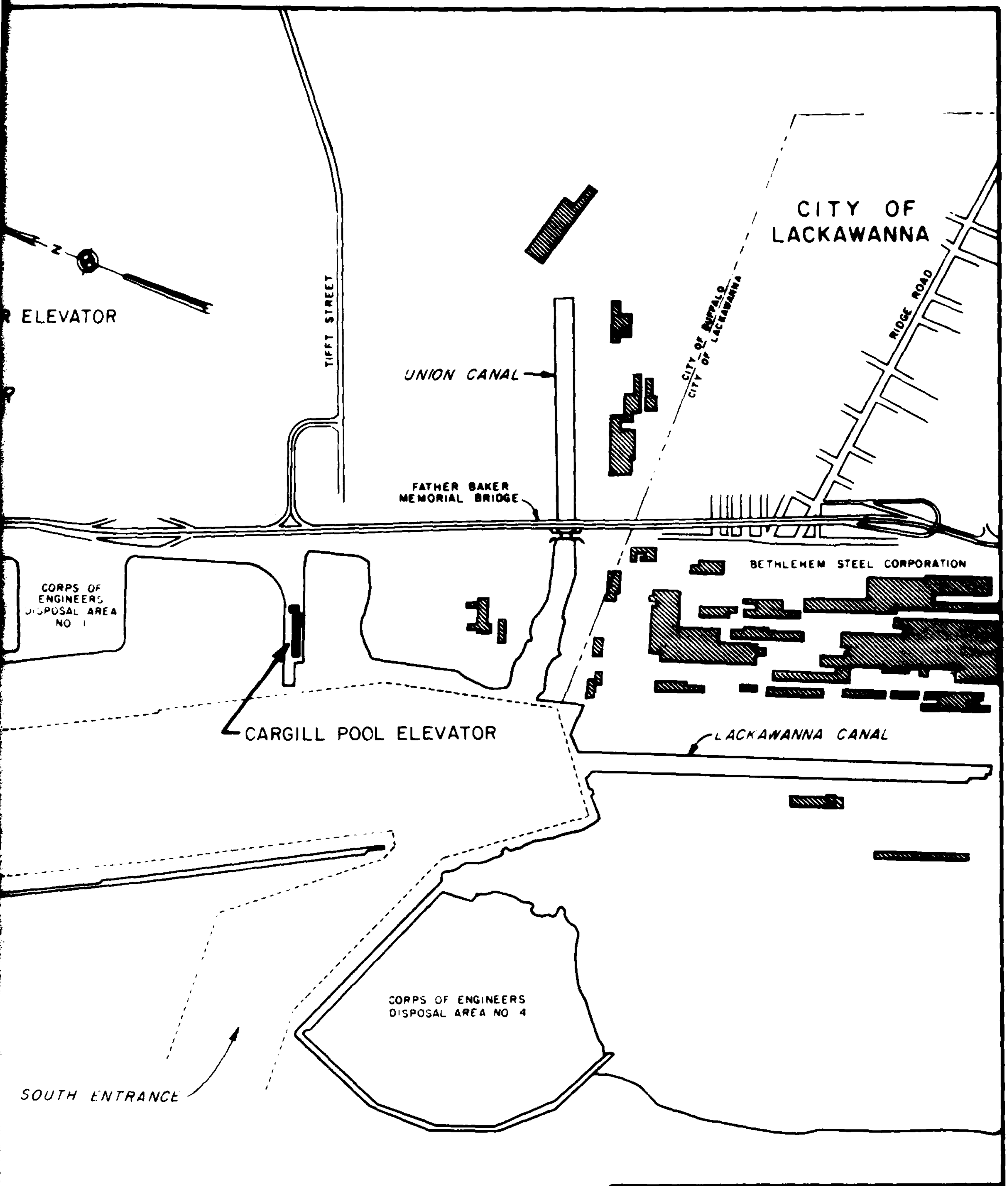

BUFFALO HARBOR, BLACK ROCK CHANNEL,
TONAWANDA HARBOR, NIAGARA RIVER
AND TRIBUTARY WATERWAYS

ABANDONED
GRAIN ELEVATORS
IN BUFFALO HARBOR

U S ARMY ENGINEER DISTRICT BUFFALO
OCTOBER 1982

PLATE 8

APPENDIX A

THE BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL STUDY

BUFFALO, NEW YORK

COST ESTIMATE

U. S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

BUFFALO HARBOR
DRIFT AND DEBRIS REMOVAL STUDY
BUFFALO, NEW YORK

APPENDIX A
COST ESTIMATES

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REASONABLE CONTRACT ESTIMATE					SHEET 1 OF 4
PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal by Harbor Chemical Energy Recovery					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Non Federal Debris				1,810,000
	Non Federal Grain Mills				30,100,000
	Federal Cost Debris				320,000
	Total Cost including Engrg., Legal, Admin. & Contingencies				$32,230,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 2 OF 4

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal by Hooker Chemical Energy Recovery

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non-Federal Line				
1.	Removal				
	Unit 1) Dilapidated Str. Heavy				
	Marine	15,345	CF	$7.05	$108,182.
	Land	86,170	CF	5.00	430,850.
	Pulling Piling Marine	19,320	CF	3.53	68,200.
	Pulling Piling Land	10,000	CF	2.51	25,100.
	Cut Piling Marine	19,580	CF	9.41	184,248.
	Cut Piling Land	12250	CF	6.69	81,953.
	Unit 2) Dilapidated Str. Light Marine	1,100	CF	15.93	17,523.
	Unit 3) Derelict Vessels	6000	CF	5.61	33,660.
	Unit 4) On Shore Debris Floatable	10,566	CF	3.80	40,151.
	Non-Floatable	325	CF	3.80	1,235.
	Unit 5) Floating Debris	1001	CF	8.35	8,308.
2.	Unloading	181,663	CF	0.3095	56,225.
3.	Disposal by Hooker Chemical	4308.	Ton	17.46	75,218.
	Disposal of Non-Floatable	[illegible]	CF	0.6557.	6,158
	Sub-Total				$1,137,011
	Mob & Demob @ 5%				56,851
	Sub-Total				1,193,862
	Profit 10%				119,386
	Total Contractor's Earnings				1,313,248
	Contingencies @ 25% ±				328,752
	Total Contractor's Earnings Plus Contingencies				1,642,000
	Engineering, Legal and Admin. Costs				168,000
	Total Non-Federal Cost				$1,810,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 3 OF 4

PROJECT: Buffalo Harbor Study, Drift and Debris Removal Disposal by Hooker Chemical Energy Recovery

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
1.	Removal				
	a) Derelict Vessels	12000.	CF	$5.6[illegible]	$67,320.
	b) On Shore Debris Floatable	21,409.	CF	3.5[illegible]	81,354.
	c) Floating Debris	2,043.	CF	8.25	16,855.
2.	Unloading	35,452.	CF	0.3095	10,972.
3.	Disposal @ Hooker Chemical	[illegible]	Tons	17.[illegible]	10,[illegible]
	Disposal Non-Floatable	12,000	CF	0.6557.	7,868.
	Sub-Total				$194,601
	Mob & Demob @ 5%				[illegible]
	Sub-Total				$204,[illegible]
	Profit @ 10%				20,[illegible]
	Total Contractor's Earnings				$224,[illegible]
	Contingencies @ 25% ±				56,[illegible]
	Total Contractor's Earnings Plus Contingenies				281 000
	Engineering, Legal and Admin. Costs				39,000
	Total Federal Cost				$320,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 4 OF 4

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal into Land Fill Site for Grain Mills

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non-Federal Cost				
1.	Removal				$
	Concrete Grain Mills	38,340,797	CF	0.30	11,502,239
2.	Disposal from Buffalo	10,656,509	CF	0.6557	6,987,467
	Sub-Total				$ 18,489,706
	Mob. & Demob. @ 5%				924,485
	Sub-Total				$ 19,414,191
	Profit @ 10%				1,941,419
	Total Contractor's Earnings				$ 21,355,610
	Contingencies @ 25% ±				5,344,390
	Total Contractor's Earnings Plus Contingencies				$ 26,700,000
	Engineering, Legal and Admin. Costs				3,400,000
	Total Non-Federal Cost				$ 30,100,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 1 OF 4

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal by Burning in Air Curtain Combustion Unit

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Non Federal Debris, Burning				$1,830,000.
	Non Federal Grain Mills				30,100,000.
	Federal Cost Debris Burning				325,000.
	Total Cost including Engrg, Legal, Admin and Contingencies				$32,255,000.

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 2 OF 4

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal by Burning in Air Curtain Combustion

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
1.	Removal				
	a) Derelict Vessels	12000.	C.F.	5.61	67,320.
	b) On Shore Debris Floatable	21,401.	CF	3.80.	81,354
	c) Floating Debris	2043.	CF	8.25.	16,855.
2	Unloading	35,452.	CF	0.3095.	10,972.
3	Disposal by Burning Floatable	21,680.	CF	0.52.	11,273.
	Disposal Non-Floatable incl. 5% of Floatable mater.	13,772.	CF.	0.6557.	9030.
	Sub-Total				196,804.
	Mob. & Demob. @ 5%				9,840.
	Sub-Total				206,644.
	Profit @ 10%				20,664.
	Total Contractors Earnings				227,308.
	Contingencies @ 25% ±				57,692.
	Total Contractor's Earning Plus Contingencies				285,000.
	Engineering, Legal and Admin. Cost				40,000.
	Total Federal Cost				$325,000.

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

GPO : 1967 O—260-053

REASONABLE CONTRACT ESTIMATE

SHEET 3 OF 4

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal by Burning in Air Curtain Combustion

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non-Federal Cost				
1	Removal				
	Unit 1) Dilapidated Str. Heavy				
	Marine	15,345	CF	$ 7.05	$ 108,182.
	Land	86,170	CF	5.00	430,850.
	Pull Piling Marine	19,320	CF	3.53	68,200.
	Pull Piling Land	10,000	CF	2.51	25,100.
	Cut Piling Marine	19,580	CF	9.41	184,248.
	Cut Piling Land	12,250	CF	6.68	81,953.
	Unit 2) Dilapidated Str. Light Marine	1100	CF	15.93	17,523.
	Unit 3) Derelict Vessels	6000	CF	5.61	33,660.
	Unit 4) On shore Debris Floatable	10,566	CF	3.80	40,151.
	Non-Floatable	325	CF	3.80	1,235.
	Unit 5) Floating Debris	1007	CF	8.25	8,308.
2	Unloading	181,663.	CF	0.3095.	56,225.
3.	Disposal by Burning	172,271.	CF	0.52.	89,581.
	Disposal Non-Floatable incl. 5% of Floatable mater.	9392.	CF	0.6557	6,158.
	Sub Total				$ 1,151,374.
	Mob & Demob @ 5%				57,569.
					1,208,943
	Profit 10%				120,894
	Total Contractor's Earnings				1,329,837.
	Contingencies @ 25% ±				332,163.
	Total Contractor's Earnings Plus Contingencies				1,662,000.
	Engineering, Legal and Admin. Costs				168,000.
	Total Non-Federal Cost				1,830,000.

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. GPO : 1967 OF—282-050

REASONABLE CONTRACT ESTIMATE					SHEET 4 OF 4
PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal into Land Fill Site for Grain Mills					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non-Federal Cost				
1.	Removal				$
	Concrete Grain Mills	38,340,797	CF	0.30	11,502,239
2.	Disposal from Buffalo	10,656,500	CF	0.6557	6,987,467
	Sub-Total				$18,489,706
	Mob. & Demob. @ 5%				924,485
	Sub-Total				$19,414,191
	Profit @ 10%				1,941,419
	Total Contractor's Earnings				$21,355,610
	Contingencies @ 25% ±				5,344,390
	Total Contractor's Earnings Plus Contingencies				$26,700,000
	Engineering, Legal and Admin. Costs				3,400,000
	Total Non-Federal Cost				$30,100,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE. GPO : 1967 O—268-050

REASONABLE CONTRACT ESTIMATE	SHEET 1 OF 5
PROJECT Buffalo Harbor Study Drift and Debris Removal Disposal into Landfill Site	INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Summary				
	Non-Federal Debris				$1,900,000
	Non-Federal Grain Mills				30,100,000
	Federal Costs Debris				330,000
	Total Cost including Engrg., Legal, Admin. and Contingencies				$32,330,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

GPO : 1967 OF—[illegible]

REASONABLE CONTRACT ESTIMATE					SHEET 2 OF 5
PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal into Land Fill Site					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non Federal Cost				
1.	Removal				
	Unit 1) Dilapitated Structures Heavy				
	Marine	15,345	CF	$ 7.05	$ 108,182.
	Land	86,170	CF	5.00	430,850.
	Pull Piling Marine	19,320	CF	3.53	68,200.
	Pull Piling Land	10,000	CF	2.51	25,100.
	Cut Piling Marine	19,580	CF	9.41	184,248.
	Cut Piling Land	12,250	CF	6.69	81,953.
	Unit 2) Dilapitated Str. Light				
	Marine	1100	CF	15.93	17,523.
	Unit 3) Derelict Vessels	6000	CF	5.61	33,660.
	Unit 4) On Shore Debris Floatable	10,566	CF	3.80	40,151.
	Non-Floatable	325	CF	3.80	1,235
	Unit 5) Floating Debris	1007	CF	8.25	8,308
2.	Unloading	181,663	CF	0.3095	56,225.
3	Disposal from Buffalo	168,682.	CF	0.6557	110,605
	Disposal from Other Locations	12,981.	CF	0.5125	6,653.
	Sub-Total				1,172,893.
	Mob & Demob @5%				58,645.
	Sub-Total				1,231,538.
	Profit 10%				123,154.
	Total Contractor's Earnings				1,354,692.
	Contingencies @ 25% ±				338,308.
	Total Contractor's Earnings Plus Contingencies				1,693,000.
	Engineering, Legal and Admin. Cost				207,000.
	Total Non-Federal Cost				$ 1,900,000.

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 3 OF 5

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal into Land Fill Site

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Federal Cost				
1.	Removal				
	a. Derelict Vessels	12,000	C.F	$5.61	$67,320
	b. On Shore Debris Floatable	21,409	CF	3.80	81,354
	c. Floating Debris	2043	CF	8.25	16,855
2	Unloading	35,452	CF	0.3095	10,972
3	Disposal from Buffalo	34,718	CF	0.6557	22,765
	Disposal from Other Locations	734	CF	0.5125	376
	Sub-Total				199,642
	Mob & Demob. @ 5%				9982
	Sub-Total				209,624
	Profit @ 10%				20,962
	Total Contractor's Earnings				230,586
	Contingencies @ 25% ±				57,414
	Total Contractor's Earnings Plus Contingenies				288,000
	Engineering, Legal and Admin. Costs				42,000
	Total Federal Cost				$330,000

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

GPO : 1967 OF—[illegible]

REASONABLE CONTRACT ESTIMATE

SHEET 4 OF 5

PROJECT: Buffalo Harbor Study, Drift and Debris Removal Disposal into Land Fill Site for Grain Mills

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
	Non-Federal Cost				
1.	Removal				$
	Concrete Grain Mills	38,340,797	CF	0.30	11,502,239
2.	Disposal From Buffalo	10,656,[illegible]	CF	0.6557	6,987,467
	Sub-Total				$18,489,706
	Mob. & Demob. @ 5%				924,485
	Sub-Total				$19,414,191
	Profit @ 10%				1,941,419
	Total Contractor's Earnings				$21,355,610
	Contingencies @ 25% ±				5,344,390
	Total Contractors Earnings Plus Contingencies				$26,700,000
	Engineering, Legal and Admin. Costs				3,400,000
	Total Non-Federal Cost				$30,100,000

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET 5 OF 5

PROJECT Buffalo Harbor Study, Drift and Debris Removal Disposal into Land Fill site for Grain Mills

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1.	Cargill "Pool" Elevator Removal	4,530,320	CF	0.30	1,359,096.
	Disposal	1,302,300	C.F.	0.6557	854,049.
	Total				2,213,145.
2.	Agway Feed Mill Removal	7,026,667	C.F.	0.30	2,108,000.
	Disposal	1,334,000	CF	0.6557	874,704.
	Total				2,982,704.
3.	Cargill "Electric" Elevator Removal	9,890,000	CF	0.30	2,967,000.
	Disposal	2,967,000	C.F	0.6557	1,945,462.
	Total				4,912,462.
4.	Marine "A" Elevator Removal	3,082,860	CF	0.30	924,858.
	Disposal	871,000	CF	0.6557	571,115.
	Total				1,495,973.
5	Cargill "Superior" Elevator Removal	6,177,150	CF	0.30	1,853,145.
	Disposal	1,709,500	CF	0.6557	1,120,919.
	Total				2,974,064.
6	Concrete Central Elevator Removal	7,633,800	CF	0.30	2,290,140.
	Disposal	2,472,500	CF	0.6557	1,621,218.
	Total				3,911,358.
	Grand Total				18,489,706.

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

A4. ANNUAL MAINTENANCE PROGRAM

Estimated Quantities - Alternative II

For annual maintenance costs, it is assumed that the equipment can recover 277 cubic feet/day of debris, refer to page 14 in the Main Report. This means, if the equipment works 21 days/month and 6 months a year, it will recover 34,902 cubic feet of debris/year. For the estimate of annual maintenance use 35,000 cubic feet of debris drifting in study area per year.

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Drift and Debris Removal Annual Maintenance Program, Disp. by Hooker Chemical

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1.	Removal				
	Unit 5) Floating Debris	100,000	CF	$8.25.	$825,000.
2	Unloading	100,000	CF	0.3095.	30,950.
3.	Disposal	2,500.	Ton	17.46.	43,650.
	Sub-Total				$899,600.
	Mob. & Demob. @ 5%				44,980.
	Sub-Total				$944,580.
	Profit @ 10%				94,458.
	Total Contractor's Earnings				1,039,038.
	Contingencies @ 25% ±				259,962.
	Total Contractor's Earnings Plus Contingencies				1,299,000.

ENG FORM 1738 APR 67 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE					SHEET OF
PROJECT Buffalo Harbor Study, Drift and Debris Removal Annual Maintenance Program, Disp. by Air Combustion Unit					INVITATION NO.
ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1.	Removal				
	Unit(5) Floating Debris	100,000	C.F.	$8.25	$825,000.
2	Unloading	100,000	CF	0.3095	30,950.
3.	Disposal	100,000	CF	0.52	52,000.
	Sub-Total				907,950.
	Mob. & Demob. @ 5%				45,398.
	Sub-Total				953,348.
	Profit @ 10%				95,335.
	Total Contractor's Earnings				1,048,683.
	Contingencies @ 25% ±				262,317.
	Total Contractor's Earnings Plus Contingencies				1,311,000.

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

REASONABLE CONTRACT ESTIMATE

SHEET OF

PROJECT Buffalo Harbor Study, Drift and Debris Removal Annual Maintenance Program, Disp. by Land Fill

INVITATION NO.

ITEM NO.	DESCRIPTION	ESTIMATED QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT
1.	Removal				
	Unit 5) Floating Debris	100,000	C.F.	$ 8.25	$ 825,000.
2.	Unloading	100,000	C.F.	0.3095	30,950.
3.	Disposal	100,000	C.F.	0.6557	65,570.
	Sub-Total				$ 921,520.
	Mob. & Demob. @ 5%				46,076.
	Sub-Total				967,596.
	Profit 10%				96,760.
	Total Contractor's Earnings				$ 1,064,356.
	Contingencies @ 25% ±				265,644.
	Total Contractor's Earnings Plus Contingencies				$ 1,330,000.

ENG FORM APR 67 1738 SUPERSEDES ENG FORM 1738, 1 APR 54, WHICH IS OBSOLETE.

A5. DEVELOPMENT OF COST ESTIMATES

Cost estimates, based on June 1982 price levels, were developed for removal, collection, and disposal of materials. Removal includes the cost of transporting to a designated staging area, structures, wrecks, and on-shore debris. Collection includes the cost of transporting to the staging area, drift material. Disposal includes the cost of unloading, processing, and reloading material at the staging area and of transporting, dumping, and burial at the Seaway Industrial Park Development, Co. Inc.

a. Removal. The proposed plan of removal is primarily by marine equipment; however, some particular locations may best be suited for land equipment removal. Five different types of debris sources have been identified, each requiring a somewhat different removal procedure. To this end, five teams or units are proposed, varying in size, labor force, and type of equipment, designed to perform a specific removal operation. These five units are as follows:

Unit 1 - for heavy waterfront structures
Unit 2 - for light waterfront structures
Unit 3 - for wrecked vessels
Unit 4 - for loose onshore debris
Unit 5 - for collection of floating debris

The following tables outline each unit and its total daily operating costs and production rates, followed by a unit cost for material particular to that unit.

Table A1 - Unit One - Heavy Weight Waterfront Structures, Land Daily Costs

Equipment and Supplies	Cost/Day $
Loader 4 CY - 1	323.60
60-Ton Crane - 1	360.40
Compressor 900 CFM - 1	262.40
Paving Breakers - 1	12.00
Dump Trucks 12 CY - 2	560.00
Pickup Truck with Cutting Equipment - 1	64.80
Wrecking Balls - 1	11.00
Buckets, Square Nose 3 CY - 1	42.40
Miscellaneous Tools, Materials, and Supplies	100.00
Subtotal	1,736.60
Labor	**Cost/Day $**
Loader Operator - 1	174.00
Crane Operator - 1	177.20
Crane Oiler - 1	134.40
Compressor Operator - 1	138.40
Labor Fore - 1	132.00
Laborers - 4	504.00
Dump Truck Drivers - 2	289.60
Welder - 1	204.80
Subtotal	1,754.40
Total	3,491.00
Overhead, 15 percent	523.65
Grand Total	4,014.65

Table A2 - Heavy Weight Waterfront Structures, Marine

Equipment and Supplies	Cost/Day $
Deck Barge or Shallow Draft Barge - 2	215.00
30-Ton Derrick Boat	630.00
250-Horse Power Tug Boat	313.75
Pile Cutter - 1	40.00
Wrecking Ball - 1	11.00
Pulling Head and Clamp	54.00
Compressor 900 CFM - 1	262.40
Chain Saws - 3	65.00
Paving Breaker - 1	12.00
Miscellaneous Tools, Materials, and Supplies	100.00
Subtotal	1,703.15
Labor	**Cost/Day $**
Tug Crew - 3	633.60
Derrick Boat Crew - 2	526.40
Oiler - 1	134.00
Deck Hand - 2	392.00
Diver with Equipment - 1	400.00
Diver's Helper - 1	263.40
Pile Fore - 1	240.00
Piledrivers - 3	614.40
Subtotal	3,203.80
Total	4,906.95
Overhead, 15 percent	736.05
Grand Total	5,643.00
Equipment and Supplies	
Same	1,703.15
Labor	
Exclude Diver and Diver's Helper	
Subtotal	2,540.40
Total	4,243.55
Overhead, 15 percent	636.53
Grand Total (for piles pulled and superstructures removed)	4,880.08

(1) Unit One - Heavy Waterfront Structures - Unit One will be responsible for removing two types of heavy structures; those fully dilapidated, requiring complete removal, using both land and marine equipment; and those only partially dilapidated, requiring removal of selective positions, using land equipment only. The size of labor force, type of equipment necessary, and anticipated production rates are arrived at through analysis of past projects, similar in scope and uses of the 1982 Heavy Construction Cost File.

Production rates for the removal of certain portions of partially dilapidated strucures are achieved by decreasing the production rates of fully dilapidated structures removed by a factor of approximately 35 percent. Though both operations are similar, the additional time required for selective removal of materials, being careful not to damage the structure to remain, must be taken into account. This decreased production is reflected in the increased unit costs for partially dilapidated structures. For land plant, it is taken from 1982 Heavy Construction Cost File.

Table A3 - Production Rates - Unit One

Dilapidated Structures	Land Production Rates	Marine Production Rates
Superstructure	800 CF/day	800 CF/day
Piles Pulled	1,600 CF/day	40 piles/day
Piles Cut	600 CF/day	60 piles/day
Partially Dilapidated Structures	**Production Rates**	**Production Rates**
Superstructure	13,500 CF/day*	590 CF/day
Piles Pulled	1,200 CF/day	30 piles/day
Piles Cut	400 CF/day	40 piles/day

* CF/day of total volume of structure based on outside dimensions. All others are CF/day of material in a structure.

All unit costs are in terms of cost per cubic foot. Piles pulled are assumed to have an average length of 40 feet and piles cut are assumed to have an average length of 10 feet. This was the approximate average length of piles checked during the inventory. One liner foot of pile is assumed to approximate 1 cubic foot.

Table A4 - Unit Costs - Unit One

Dilapidated Structures	Marine Unit Cost $	Land Unit Cost $
Superstructure	7.05/CF	5.00/CF
Piles Pulled	3.53/CF	2.51/CF
Piles Cut	9.41/CF	6.69/CF
Partially Dilapidated Structures	**Unit Cost $**	**Unit Cost $**
Superstructure	8.27/CF	0.30/CF*
Piles Pulled	4.07/CF	3.35/CF
Piles Cut	12.20/CF	10.04/CF

* Cost for reinforced concrete demolition on total volume of the structure.

(2) Unit Two - Light Weight Waterfront Structures

Table A5 - Daily Costs - Unit Two

Equipment and Supplies	Cost/Day $
Deck Barge or Shallow Draft Barge - 1	215.00
Tug Boat, 250-Horse Power - 1	313.75
30-Ton Derrick Boat - 1	630.00
Chain Saws - 2	43.33
Miscellaneous Tools, Materials, and Supplies	50.00
Subtotal	1,252.08
Labor	**Cost/Day $**
Tug Crew - 3	633.60
Derrick Boat Crew - 2	526.40
Deckhand - 1	196.00
Pile Fore - 1	240.00
Piledrivers - 3	614.40
Subtotal	2,210.40
Total	3,462.48
Overhead, 15 percent	519.37
Grand Total	3,981.85

Two locations are identified as being either dilapidated or partially dilapidated and of light construction. The locations are adjacent to each other on the lower Niagara River in the city of Niagara Falls. Most such structures do not have piles. Where piles are included, Unit One rates apply.

It is anticipated that Unit Two would be able to remove two of these smaller locations, or approximately 300 cubic feet per day. To account for the time required to travel from location to location and for hauling the debris, this figure has been reduced by a factor of 20 percent or to 250 cubic feet/day.

As in Unit One, the production rates for material removed from partially dilapidated structures have been reduced by 35 percent due to the slower and more careful process of working around a structure that is to be retained.

Table A6 - Production Rates - Unit Two

Dilapidated Structure	Production Rate
Superstructure	250 CF/day
Partially Dilapidated Structure	Production Rate
Superstructure	185 CF/day

Table A7 - Unit Costs - Unit Two

Dilapidated Structures	Unit Cost $
Superstructure	15.93/CF
Partially Dilapidated Structures	Unit Cost $
Superstructure	21.52/CF

(3) Unit Three - Derelict (Wrecked) Vessels

Table A8 - Daily Costs - Unit Three

Equipment and Supplies	Cost/Day $
Steel Deck Barges - 2	430.00
30-Ton Derrick Boat	630.00
250-Horse Power Tug Boat	313.75
Bucket, Square Nose, 3 CY - 1	42.40
Miscellaneous Tools, Materials, and Supplies	100.00
Subtotal	1,516.15
Labor	**Cost/Day $**
Derrick Boat Crew - 3	722.00
Tug Crew - 3	633.60
Pile Driver Fore - 1	240.00
Pile Driver Crew - 3	614.40
Diver with Equipment - 1	400.00
Diver's Helper	263.40
Subtotal	2,873.40
Total	4,389.55
Overhead, 15 percent	658.43
Grand Total	5,047.98

There are three derelict vessels, two of steel and wood construction, in the study area with known quantities totaling 18,000 cubic feet. Though the quantity of material is not great, it has to be considered. The average of 6,000 cubic feet can be established.

It is estimated that Unit Three is capable of removing the average vessel in 7 days time, including setting up and hauling the material which yields approximately 900 CF of material removed per day.

Table A9 - Production Rates - Unit Three

	Production Rate
Derelict (Wrecked) Vessels of Steel Construction	900 CF/day

Table A10 - Unit Costs - Unit Three

	Unit Cost $
Derelict (Wrecked) Vessels of Steel Construction	5.61/CF

(4) Unit Four - Loose Onshore Debris

Table All - Daily Costs - Unit Four

Equipment and Supplies	Cost/Day $
Front End Loader - 1	323.60
Steel Deck Barge or Shallow Draft Barge - 1	215.00
Launch, 150 Horse Power - 1	160.80
Chain Saws - 2	43.35
Miscellaneous Tools, Materials, and Supplies	50.00
Subtotal	792.75
Labor	**Cost/Day $**
Loader Operator - 1	174.00
Pile Driver Crew - 3	614.40
Pile Driver Fore - 1	240.00
Launch Operator	218.80
Subtotal	1,247.20
Total	2,039.95
Overhead, 15 percent	305.99
Grand Total	2,345.94

The latest inventory of loose onshore debris indicates there are 33 locations in Buffalo Harbor totaling 32,000 cubic feet of material or approximately 970 cubic feet per location.

Unit Three is designed to be able to cut, load, and haul an estimated 960 cubic feet of material per day. This figure must be reduced by 20 percent, however, to allow time to locate, set up, haul, and move from site to site.

Table A12 - Production Rate - Unit Four

	Production Rate
Loose Onshore Debris	770 CF/day

To allow for final cleanup of all shorefront area at the end of the project, the unit costs have been increased by 25 percent to compensate for the additional time.

Table A13 - Unit Costs - Unit Four

	Unit Cost $
Loose Onshore Debris	3.80/CF

(5) Unit Five - Collection - A fifth type of unit will be required to collect drift material. The costs for this unit are outlined below.

Table A14 - Daily Cost - Unit Five

Equipment and Supplies	Cost/Day $
Shallow Draft Barge or Float - 1	215.00
Launch, 150 Horse Power	160.80
Chain Saws - 2	43.35
Hoist, 2 ton - 1	77.60
Miscellaneous Tools, Materials, and Supplies	100.00
Subtotal	596.75
Labor	**Cost/Day $**
Pile Driver Crew - 3	614.40
Pile Driver Fore -1	240.00
Hoist Operator	263.20
Launch Operator	218.80
Subtotal	1,336.40
Total	1,933.15
Overhead, 15 percent	289.97
Grand Total	2,223.12

It is estimated that on an average day, approximately 3,050 cubic feet of drift exists in the study area with the largest concentration being within the Buffalo River and the Black Rock Channel. This figure substantially increases following a heavy railfall or high winds when exceptionally high waters are experienced, transferring much of the loose onshore debris into the harbor waters.

In order to make one complete sweep of the harbor and remove all floating debris sighted, it is estimated to take 11 days. This yeilds an average production rate of drift removal of 277 cubic feet/day.

It is proposed that Unit Five operate during the entire cleanup project as concentrations of drift are not expected to decline until project completion.

Table A15 - Production Rate - Unit Five

	Production Rate
Drift	277 CF/day

Table A16 - Unit Costs - Unit Five

	Unit Cost $
Drift	8.05/CF

b. Summary of Removal and Collection Costs. A complete list of labor and equipment requirements implicit in the total removal and collection cost, is given in Table A17. Table A18 provides a summary of the removal and collection costs.

Table A17 - Summary of Removal and Collection Costs

	High Rate $	Cost/Day $
Labor Foreman	16.55	132.00
Laborer	15.75	126.00
Pile Foreman	30.00	240.00
Pile Driver Journeyman	25.60	205.00
Launch Operator	27.35	219.00
Lineman	24.50	196.00
Derrick Operator	32.90	263.00
Derrick Engineer	32.90	263.00
Crane Operator	22.15	177.00
Oiler	16.80	134.00
Dozer Operator	21.75	174.00
Loader Operator	21.75	174.00
Tug Operator	27.35	219.00
Tug Engineer	27.35	219.00
Compressor Operator	17.30	138.00
Dump Truck Driver	18.10	145.00
Driver with Equipment	50.00	400.00
Driver's Helper	32.92	263.00

Equipment - Total List	Cost/Day $
250-Horse Power Tug Boat	313.75
Launch, 150 Horse Power	160.80
Deck Barge or Shallow Draft Barge	215.00
30-Ton Derrick Boat	630.00
4-Inch Pumps	40.00
Pile Cutters - 2	80.00
Wrecking Ball - 2	22.00
Pulling Head/Clamp	54.00
Compressor, 900 cfm and 3-50 foot hoses	262.40
Chain Saws - 3	65.00
Paving Breakers - 2	24.00
Front End Loader	323.60
Buckets, Square Nose, 3 CY - 2	84.80
Dump Trucks, 12 CY - 2	560.00
60-Ton Crane	360.40
Bulldozer D-6 - 1	221.60
Hoist, 2-Ton - 1	77.60
Air Curtain Combustion Unit	900.00

Table A18 - Removal and Collection Summary Table for Estimating Purposes (1)

	Type of Material Removed	Rounded Daily Cost of Operations	Production Rate (CF/Day)	Total Quantity to Remove (Cu. Ft.)	Estimated Unit Days	Mat. Unit Costs to Remove ($/CF)	Total Cost
		$				$	$
Unit One	Dilapidated Structures						
	a. Superstructure, Marine	5,640	800	15,345	19	7.05	108,182
	Superstructure, Land	4,000	800	86,170	108	5.00	430,850
	b. Piles Pulled, Marine	5,648	1,600	19,320	12	3.53	68,200
	Piles Pulled, Land	4,016	1,600	10,000	6	2.51	25,100
	c. Piles Cut, Marine	5,646	600	19,580	33	9.41	184,248
	Piles Cut, Land	4,014	600	12,250	20	6.69	81,953
	Partially Dilapidated Structures						
	a. Superstructure, Marine	4,879	590	-	-	8.27	
	Superstructure, Land	4,050	13,500	38,340,797	2,840	0.30	11,502,239
	b. Piles Pulled, Marine	4,884	1,200	-	-	4.07	
	Piles Pulled, Land	4,020	1,200	-	-	3.35	
	c. Piles Cut, Marine	4,880	400	-	-	12.20	
	Piles Cut, Land	4,016	400	-	-	10.04	
Unit Two	Dilapidated Structures (Light)	4,000	250	1,100	4	15.93	17,523
	Partially Dilapidated Structures (Light)	4,000	185	-	-	21.52	
Unit Three	Derelict Vessels	5,049	900	18,000	20	5.61	100,980
Unit Four	Loose Onshore Debris	2,925	770	31,975	42	3.80	121,505
	Nonfloatable	2,925	770	325		3.80	1,235
Unit Five	Drift	2,225	270	3,050	12	8.25	25,163
	Total Quantity			38,557,912	Total Cost		12,667,178

(1) Excluding contingency, Mob and Demob, Profit, Engineering, Legal, and Administrative Costs.

c. Disposal. Disposal includes the cost of unloading, processing, and reloading the collected material at the staging area as well as hauling, dumping, and burying it at the landfill site.

The following outlines the daily operating costs, production rates, and unit costs for this process.

(1) Unloading - It is assumed that unloading the debris from the carrier barges onto the staging site will be done using a clamshell/crane. The daily crew cost is given in Table A19. The entire barge cost has been assigned to the removal operation.

Table A19 - Daily Costs - Unloading

	Cost/Day $
Equipment	
Clamshell/Crane	360.40
Bucket, Square Nose, 3 CY	42.40
Subtotal	402.80
Labor	
Crane Operator	177.00
Crane Oiler	134.00
Subtotal	311.00
Total	713.80
Overhead, 15 percent	107.05
Grand Total	820.85

The production rate of the unloading area is expected to equal the amount of material removed/collected by Units One through Four, excluding work effort on partially dilapidated structures to be done by others. This rate could be as high as 3,100 cubic feet/day in the early stage of the project. However, production rates per unit and debris volumes per debris source vary. As a result, one or more removal plants (units) will complete work tasks before others. Accordingly, a weighted average production rate of 2,652 cubic feet/day over the life of the project has been used to represent planned removal operations.

The implied number of crew-days required is thus equal to 217,115 cubic feet (total amount of debris) divided by the 2,652 cubic feet/day rate and equal to 82 crew-days.

Summary of Costs - Unloading - Unloading unit costs are provided in Table A20 and total costs in Table A21.

Table A20 - Unit Cost - Unloading

$$\frac{\$820.85}{2{,}652\ \text{CF/day}} = \$0.3095/\text{CF}$$

Table A21 - Total Costs - Unloading

Total Cost = $820.85/Crew-Day X 81.937 Crew-Days = $67,258

NOTE: Unloading cost for the majority of the materials from the Concrete Grain Mills is not necessary.

(2) Processing, Loading, Hauling, Dumping, and Burying - Seaway Industrial Park Development Company, Inc., Landfill Site at 4800 River Road, Town of Tonawanda, provided cost estimates for this part of the process. The prices quoted were $4.50/cubic yard for dumping and burying for all types of materials, concrete, steel, wood, and earth. For this reason the nonfloatable material was converted into cubic feet from tons.

The cost estimates assume the use of 12-cubic yard demolition dump trucks carrying 7 cubic yards of debris. Thus, required truckloads per day would average 2,652 cubic feet/189 cubic feet per truckload, which equals approximately 14 truckloads per crew day.

The estimates also assume that 99.87 percent of the total amount of material will be shipped from the Buffalo staging areas, which needs to be located, and the remaining 0.13 percent can be loaded directly from the barges into the dump trucks. Hence, the required number of truckloads for Buffalo will be 4,095 crew days X 14 truckloads per crew day equaling 57,330 truckloads. The estimates of other locations are 5 crew days X 14 truckloads per crew day, equaling 70 truckloads. A cost for trucking is added to each cubic yard of material of $0.30/cubic yard per mile.

Total costs are given in Table A22, unit cost in Table A23.

Table A22 - Costs of Processing, Loading, Hauling, and Dumping

From Buffalo	
57,330 truckloads X $54/truckload	$3,095,820
15 miles haul X $3.60/mile X 57,330	3,095,820
Subtotal	6,191,640
Overhead, 15 Percent ±	928,920
Subtotal	7,120,560
From Other Locations	
70 truckloads X $54/truckload	3,780
10 miles haul X $3.60/mile X 70	2,520
Subtotal	6,300
Overhead, 15 Percent	945
Subtotal	7,245
Total	$7,127,805

Table A23 - Unit Costs of Processing, Loading, Hauling, and Dumping

Unit Costs = Total Cost/Production	
From Buffalo: $7,120,386/10,859,479 CF	$0.6557/CF
From Other Locations: $7,245/14,136 CF	$0.5125/CF
Total Disposal Costs	

Total disposal costs include the costs of unloading, processing, and loading at the staging site in addition to hauling and dumping at the landfill site. A summary of these costs is provided in Table A24.

(3) Total Disposal Costs

Table A24 - Total Disposal Costs (1)

	$ 67,258
Processing, Loading, Hauling, and Dumping	7,127,805
Total	$7,195,063

(1) Excluding contingencies, Supervision, Administration, Engineering, and Design.

d. Summary of Costs. A summary of costs by operation is presented in Table A25, and by community in Table A26.

Table A25 - Summary of Total Estimated Project Costs by Operation

Collection	$ 25,163
Removal	12,642,015
Disposal	7,195,063
Total Project Cost	$19,862,241

Table A26 - Summary of Quantities

		Totals	Buffalo				Tonawanda				Wheatfield				Niagara			
			Federal		Non-Federal		Federal		Non-Federal		Federal		Non-Federal		Federal		Non-Federal	
			CF	$	CF	$	CF	$	CF	$	CF	$	CF	$	CF	$	CF	$
Unit One	Dilapidated Structures																	
	Marine	15,345	-		14,480	116,060			-		-		765	6,022	-		100	787
	Land	86,170	-		86,170	514,021			-		-		-		-		-	
	Structures																	
	Piles Pulled	10,721,000																
	Marine	19,320	-		16,520	74,261			1,400	6,093	-		1,400	6,094	-		-	
	Land	2,000	-		10,000	34,752			-		-		-		-		-	
	Piles Cut																	
	Marine	19,580	-		11,880	123,257			1,200	12,278	-		6,500	66,511	-		-	
	Land	8,650	-		12,250	93,776			-		-		-		-		-	
	Partially Dilapidated Structures (Heavy)																	
	Marine																	
	Land Grain Mills				38,340,797	18,489,706												
	Piles Pulled																	
	Marine																	
	Land																	
	Piles Cut																	
	Marine																	
	Land																	
Unit Two	Dilapidated Structures (Light)																	
	Marine	1,100	-		-		-		-		-		-		-		1,100	18,427
	Land	0																
	Partially Dilapidated Structures (Light)																	
	Marine	0																
	Land	0																
Unit Three	Derelict Vessels	18,000	12,000	78,902	6,000	39,451												
Unit Four	Onshore Debris	31,975	20,675	98,520	10,200	48,605					667	3,083	333	1,539	67	310	33	153
	Marine																	
	Nonfloatable Marine	325 CF			175	833							100	462			50	231
Unit Five	Floating Debris																	
	Marine	3,050	2,043	18,827	1,007	9,280												
	Total			196,249		19,544,002		0.00		18,371		3,083		80,628		310		19,598

Disposal by Burning

Air Curtain Combustion Unit — $900.00/day

Production (15 ton/hour X 2,000) - 50 lb/CF = 600 CF/hr
600 CF/hr X 7 hrs/day = 4,200 CF/day

Unit Cost 4,200 CF/day at $900 cost/day = $0.21/CF
$0.21 CF cost for burning + $0.31/CF for unloading =

Total Cost $0.52/CF

Disposal at Hooker

Production

3,500 tons/day taken from telephone conversation with Mike Loree, Hooker Plant.

Processing, loading, will be used from paragraphs 27 and 28.

14 truckloads/day at 8 tons/truck = 112 tons/day (193,951 CF of burnable debris X 50 lbs/CF) - 2,000 = 4,850 tons

4,850 tons - 112 tons/day = 43 days X 14 trucks/day = 602 truckloads

Cost of Processing, Loading, Hauling to Hooker

602 truckloads at $54/truckload =	$32,508
25 miles haul at $0.18/tone/mile X 8 X 602 =	21,672
Subtotal	54,180
Overhead, 15 Percent	8,127
Total	$62,307

Unit Cost

$62,307 - (4,850 tons) = $12.85/ton

Unit Cost for cutting material into 3-foot pieces:

a. Labor Fore	$132
b. Laboiers	252
c. Chain Saws	65
Subtotal	449/day
Overhead, 15 Percent	67
Total	$516/day

$516/day - 112 tons/day = $4.61/ ton

Summary of Unit Cost

$12.85/ton for loading and hauling
4.61/ton for processing
$17.46/ton Use

BUFFALO NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX B

ECONOMIC EVALUATION

BUFFALO NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX B

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BUFFALO NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX B

ECONOMIC EVALUATION

B1. STUDY PURPOSE AND PLAN DESCRIPTION

a. Purpose.

The purpose of the Buffalo Harbor Drift and Debris Study is to determine the feasibility of establishing a project for the collection, removal and disposal of drift from the study area. This geographic area includes the Buffalo Harbor and the Upper Niagara River and tributary streams. (Figure B1) The study will also determine the sources of drift such as dilapidated shorefront structures, loose onshore debris and derelict vessels.

The presence of floating drift in the study area constitutes a distinct menace to small-boat navigation. Great numbers of small craft use Buffalo Harbor, Lake Erie and the Niagara River and boat operators must exercise extreme care in navigating to avoid striking floating debris. The drift is most prevalent in the early spring following winter thaws and at various times during the summer following severe rain and wind storms. The majority of drift is transported via tributary streams and enters the harbor during high streamflow conditions. The greatest hazards to small-boat navigation is experienced at night or during fog conditions when the presence of drift is difficult to discern. Large commercial vessels experience little or no difficulty in navigating within the harbor because of drift.

In addition to difficulties to navigation other problems caused by drift and drift sources include: the unpleasant aesthetic effect of a shorefront cluttered with debris, decaying marine structures and abandoned vessels; hindrance to the utilization of the shorefront for commercial, recreational or residential purposes; interference with the operation of the Black Rock Lock; and clogging of municipal sewer outlets.

b. Plan Descriptions.

The economic analysis assesses the benefits and costs of four alternative plans for debris removal within the study area. A number of alternative plans have been formulated to reduce or eliminate drift and debris problems within the harbor area. At any time during the navigation season there may be a considerable amount of drift in the study area. This material presents a hazard to small-boat navigation, clogs storm sewer outlets, blocks marina entrances, interferes with gate operation of the Black Rock Lock and creates an unsightly waterfront.

The drift to be removed consists of natural drift such as trees, logs, limbs and tree root masses; portions of deteriorated waterfront structures such as timbers and planks; and debris generated by human activity such as cans, oil drums, bottles, boxes, chains, cable reels and miscellaneous trash.

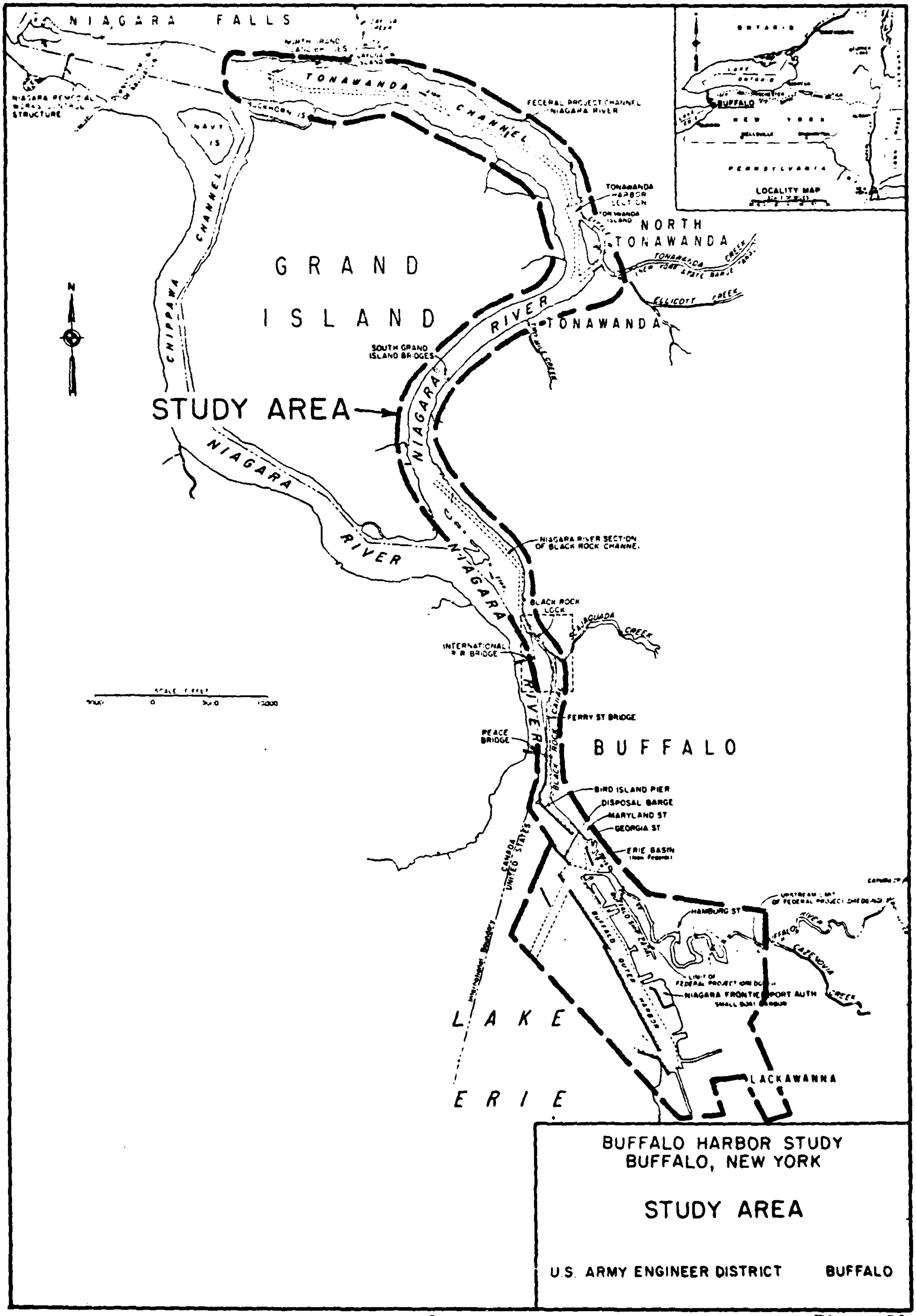

NIAGARA FALLS
TONAWANDA CHANNEL
FEDERAL PROJECT CHANNEL NIAGARA RIVER
NIAGARA REMEDIAL WORKS CONTROL STRUCTURE
NAVY IS
CHIPPAWA CHANNEL
GRAND ISLAND
TONAWANDA HARBOR SECTION
NORTH TONAWANDA
TONAWANDA CREEK
ELLICOTT CREEK
TONAWANDA
RIVER
SOUTH GRAND ISLAND BRIDGES
STUDY AREA
NIAGARA RIVER
NIAGARA RIVER SECTION OF BLACK ROCK CHANNEL
BLACK ROCK LOCK
SCAJAQUADA CREEK
INTERNATIONAL R.R. BRIDGE
FERRY ST BRIDGE
PEACE BRIDGE
BUFFALO
BIRD ISLAND PIER
DISPOSAL BARGE
MARYLAND ST
GEORGIA ST
ERIE BASIN
CANADA
UNITED STATES
HAMBURG ST
BUFFALO RIVER
CAZENOVIA CREEK
BUFFALO OUTER HARBOR
NIAGARA FRONTIER PORT AUTH
LAKE ERIE
LACKAWANNA
ONTARIO
BUFFALO
NEW YORK
PENNSYLVANIA
LOCALITY MAP
BUFFALO HARBOR STUDY
BUFFALO, NEW YORK
STUDY AREA
U.S. ARMY ENGINEER DISTRICT BUFFALO

Figure B1

The amount and location of drift in the study area is dependent to a great extent upon climatological conditions. During the spring thaw and at various times following heavy rainfall or periods of strong wind, large amounts of drift enter the waterways. Strong winds cause drift to shift location and collect in many different areas depending on wind direction. However, most of the drift tends to accumulate at certain locations along the shoreline, at bridges, small inlets and other locations where features of riverbanks or structures form natural catch basins.

The following alternatives will be evaluated:

(1) Alternative I - No Action Plan - This alternative assumes that no further action will be taken to collect floating debris. At present, drift removal is primarily accomplished by the Corps of Engineers only as an emergency measure to eliminate hazards to navigation and prevent drift which accumulates in the Black Rock Channel from impairing operation of lock gates at the Black Rock Lock.

(2) Alternative II - Continuous Removal Plan - This alternative establishes an annual program for the continuous removal of drift in the project area each year. Disposal options for the material collected consist of: destruction by burning, disposal by landfill, or energy resource recovery. Specific techniques to implement these options are:

(a) Destruction by a pollution free air curtain combustion unit.

(b) Landfill at an existing sanitary facility.

(c) Energy resource recovery (reuse) through burning of debris in a furnace to produce energy for power plants, heating or industrial processes.

(3) Alternative III - One-Time Cleanup Plan - A one-time cleanup program would be implemented to rid the study area of the major sources of drift. This plan consists of removing all sources of drift, including dilapidated and partially dilapidated structures, loose onshore debris, nearshore floating debris, and derelict vessels. Disposal options for material collected would be the same as Alternative II.

(4) Alternative IV - One-Time Cleanup and Continuous Removal Plan - This plan combines elements from Alternatives II and III. That is, implementation of a one-time cleanup program to rid the study area of the major sources of drift is combined with a formal annual maintenance program. Disposal options for material collected would be the same as Alternative II.

B2. ECONOMIC EVALUATION

a. Overview.

An economic analysis of the proposed debris removal plans was developed by comparing the equivalent annual benefits accruing to each plan over its economic life with the equivalent average annual costs. The development of costs and benefits follows standard Corps of Engineers guidelines. All goods

and services used in the development of the project are estimated in monetary terms at 1982 price levels. Future damages and benefits have been discounted at a project interest rate of 7-5/8 percent.

b. Cost Summary.

Table B1 compares the total cost for each alternative and disposal option. Disposal Option C is the least cost method for each alternative. Therefore, the preliminary economic evaluation will presume that Disposal Option C would be implemented under any program of debris collection. The low cost, minimal adverse environmental impact, and potential recovery of energy via combustion under this disposal option were considered to be desirable features. No quantitative savings for the energy produced from the material will be addressed; since any net energy production is considered to be incorporated into the unit cost per cubic yard of material collected.

Table B1 - Total Cost Summary Alternative Plans and Disposal Options

Disposal Option A Combustion	Disposal Option B Landfill	Disposal Option C Energy Resource Recovery
Alternative II: Annual Drift Removal		
$459,000	$466,000	$455,000
Alternative III: One-Time Removal of Drift Sources		
$2,155,000	$2,230,000	$2,130,000
Alternative IV: One-Time Cleanup of Drift Sources With Annual Maintenance		
$2,116,000	$2,193,000	$2,104,000

(1) First Costs - Estimates of project costs were developed for removal, collection and disposal of materials for each project alternative. Removal includes the cost of transporting to a designated staging area structures, wrecks and onshore debris. Collection includes the cost of transporting to the staging area drift material. Disposal includes the cost of unloading, processing and reloading material at the staging area and transportation to the disposal site. Table B2 provides a summary of first costs for each alternative. Estimated costs are based on June 1982 price levels and include construction contingencies and allowances for supervision and administration.

Table B2 - Summary of Estimated First Costs

	Alternative Plans		
	II	III	IV
	Continuous Removal	One-Time Removal	One-Time Cleanup and Continuous Removal
	$	$	$
Non-Federal Costs			
Estimated Costs - Floating Debris	243,000	-	243,000
Estimated Costs - Onshore Debris	-	1,313,200	1,303,300
Contingencies at 25 Percent	61,000	328,800	386,700
Supervisory and Administrative Costs		168,000	168,000
Total Non-Federal Costs	304,000	1,810,000	2,101,000
Federal Costs			
Estimated Costs - Floating Debris	121,000	-	121,000
Estimated Costs - Onshore Debris	-	224,800	204,600
Contingencies at 25 Percent	30,000	56,200	84,400
Supervisory and Administrative Costs	-	39,000	39,000
Total Federal Costs	151,000	320,000	446,000
Total Project Cost	455,000	2,130,000	2,547,000
Interest During Construction (1)	(2)	82,500	81,000 (2)
Total Project Investment Costs	455,000	2,212,500	2,628,000

(1) IDC based on project interest rate of 7-5/8 percent compounded monthly for a 6-month construction period.

(2) IDC not calculated for Continuous Removal Program and continuous removal component of Alternative IV.

Interest During Construction (IDC) is computed for Alternatives III and the one-time cleanup component of Alternative IV. IDC costs account for the cost of investment during construction and are added to initial costs to determine total project investment costs. Average annual costs are determined based on total investment costs which include IDC. Planning guidance requires that IDC *should be calculated at* compound interest, at the project discount rate and added from the date expenditures are made. An estimate of the total project cost, length of construction period, expenditure schedule and length of compounding periods is required. The project interest rate applicable is

7-5/8 percent and is compounded monthly for a 6-month construction period. Expenditures are considered to be incurred at the initial point of the construction sequence. IDC costs for Alternatives III and IV are calculated based on a monthly interest rate factor of .006354 and are presented in Table B2. IDC costs are excluded for Alternative II as costs are presented on an annual basis and the continuous removal program will vary in length from season to season.

(2) Annual Costs - Estimated annual costs are based on a 50-year economic life and interest and amortization charges are based on an amortization factor of 0.07832. Table B3 summarizes the annual costs for each alternative. There is no initial investment cost for Alternative II, since all expenditures consist of annual debris removal costs regardless of the amount of debris present in the harbor. Therefore, the estimated annual cost should be considered as representative of a long-term average annual expenditure. Alternative IV represents a combination of Alternative II, the continuous cleanup program and Alternative III, the one-time removal of source structures. No first cost or annual cost are presented for Alternative I as this is the No Action Plan.

Table B3 - Summary of Annual Costs

	Alternative Plans		
	II	III	IV
Plan Feature	Continuous Removal	One-Time Removal	One-time Cleanup and Continuous Removal
	$	$	$
Project Investment Continuous Program - Floating Debris	455,000		455,000
One-time Cleanup of Onshore Debris - Investment Costs	-	(2,212,500)	(2,173,000)
Interest (.07625)	-	168,700	165,700
Amortization (.00199)	-	4,400	4,300
Total Annual Costs	455,000 (1)	173,100	625,000

(1) Cost estimate for Alternative II is for annual costs incurred each year. Therefore, first costs equal annual costs.

c. Evaluation of Benefits.

The benefit categories of the proposed drift and debris program for Buffalo Harbor and the Upper Niagara River include: navigational damages

avoided, enhancement of property values, and reduction of maintenance costs incurred by public agencies. Navigational benefits result from a reduction in the number of boat/drift collisions and a reduction in debris removal costs and damages to marina facilities. Land enhancement benefits result from an increased market value for existing property by removing the drift and debris sources located either on or adjacent to the harbor or Niagara River. These debris sources may consist of abandoned or dilapidated structures, waterfront facilities, and onshore debris. Maintenance reduction benefits result from reductions in the annual operating costs for public agencies by reducing or eliminating the need for clearing and snagging operations.

(1) Navigational Benefits - Navigational benefits result from a reduction in the expected number of boat/drift collisions and a reduction in the cost of repairing marina facilities damaged by drift. Also a category for future costs avoided is included since drift containment systems will not have to be replaced under certain alternatives. These savings were determined by comparing existing conditions and boat/drift collision costs and damages to facilities with those which would be expected if the debris were removed.

A survey of marinas, yacht clubs, marine repair yards and public facilities (i.e., U.S. Coast Guard, Erie County Sheriff's Office) was conducted to collect information on repair costs for boat/debris collision damages, the type of damage, the average repair costs, and the cost of repair to marina facilities due to damages resulting from floating debris.

A field survey was conducted in April and May 1982 and its major components are summarized below:

- 34 establishments were contacted.
- 22 facilities reported boat/debris damages totalling $97,700.
- 10 establishments reported damages to their facilities due to drift and debris or cleanup costs to remove debris totalling $31,000.
- 4 facilities reported damages but gave no details.
- 8 facilities did not respond to the survey.
- 3 marinas indicated that expenditures for containment of floating debris was approximately $33,000.

The information collected during the survey represents a typical year in terms of damages caused by drift and debris. Thus, 1982 was taken as the base year and damages reported in the survey were determined to be representative of average annual damages. Table B4 presents a summary of the information collected.

Field interviews of local ship repair yards, discussions with the U.S. Coast Guard and the Harbormaster for the Port of Buffalo, indicated that there were few damages, if any, to commercial vessels from boat/drift collisions. No repairs to commercial vessels in the study area as a result of collision with drift were reported. Thus, damage to commercial vessels appears to be insignificant and further investigation was not considered.

Four marinas reported boat damages due to collisions with drift but did not have any information regarding the cost of repairs, also eight facilities did not respond to the survey. For the purpose of this economic analysis it is assumed that each of these facilities incurred some degree of financial loss due to boat/drift collisions. Therefore, the average cost of boat/drift collision repairs, based upon the 22 facilities that provided data, was used to approximate damages for the nonrespondents. The average cost at each marina reporting damages was $4,440. Assigning the mean cost of repairs to each of the 12 facilities for which data are not available results in an adjusted total cost of repairs due to boat/drift collisions of $151,000.

There are two major factors which influence boat/drift collisions damages over the 50-year project life. One factor is the increase in the amount of drift in the study area and the other is the growth in boating activity. The annual volume of drift that will be present during the project lifetime will be influenced by several factors. Additional waterfront activity and population growth will tend to have an expansionary effect on the amount of drift that will exist. However, since a major amount of drift within the study area is primarily a result of tributary sources, the amount of drift and debris present in any given year is also dependent upon the amount of runoff carried into the study area by these streams. Runoff, in turn, is affected by climatological conditions which tend to vary from year to year. Due to these factors and a lack of detailed information on the specific origin of this material within the study area the amount of drift and debris is assumed to be constant over the project lifetime.

Growth in boating activity is expected to occur over the project planning period resulting in an increased potential for boat/drift collision damages. Current data on the size of the recreational fleet in the Buffalo area are available from several sources.

Data collected during the survey of marina operators revealed that approximately 3,000 recreational small craft are based at the marina facilities within the study area (Table B4). Approximately 14,400 transient boats used these facilities during 1981. The general opinion of local operators is that boating is an increasingly popular activity that will continue to grow in the future. Above average growth rates have been associated with the use of sailboats.

Table B4 - Survey Results - Summary Recreational Fleet Data Reported

Vessel Classification (Length in Feet)	Number of Boats
Wet Slips:	
<16 Outboard	153
16-25 Outboard	257
26-39 Outboard	153
16-25 Inboard	569
26-39 Inboard	103
40-60 Inboard	11
16-25 Cruiser	12
26-39 Cruiser	147
40-64 Cruiser	2
<16 Sailboat	5
16-25 Sailboat	59
26-39 Sailboat	103
Dry Stack	28
Subtotal	1,602
Unclassified	1,381
Total	2,983

Two major data sources for statistical sources on current and future recreational boating are the New York State Office of Parks and Recreation and the Department of Motor Vehicles. The Department of Motor Vehicles is responsible for motor boat registration in the State of New York, a function it acquired from the Office of Parks and Recreation in the early 1970's.

Information on boat ownership for individual counties is available. However, these statistics are not comparable on a historical basis because of dramatic changes in the system for storing and processing the registration information as it was integrated into the computerized motor vehicle information system. Thus, actual boat registrations in New York State declined during the 1970's. Most, if not all, of the apparent decline in the number of registrations can

be traced to this change in the registration information system (NYSOPR, 1981). Furthermore, in New York State nonpowered vessels are not required to be registered; thus, sailboats, canoes, kayaks, and rowboats are not counted. Therefore, a historical time series evaluation of New York State boater registration data to forecast future growth of recreational boating would not yield realistic results.

National boating industry data was also reviewed to determine the short-term outlook for growth in recreational boating. Based on this information, recreational boat ownership has increased over the last decade by 20 percent as is shown in Table B6 and Figure B2. Several studies on recreation in New York State also reveal an increase in recreational boating (NYSOPR, 1981; NYSOPR, 1978; Noden and Brown, 1977).

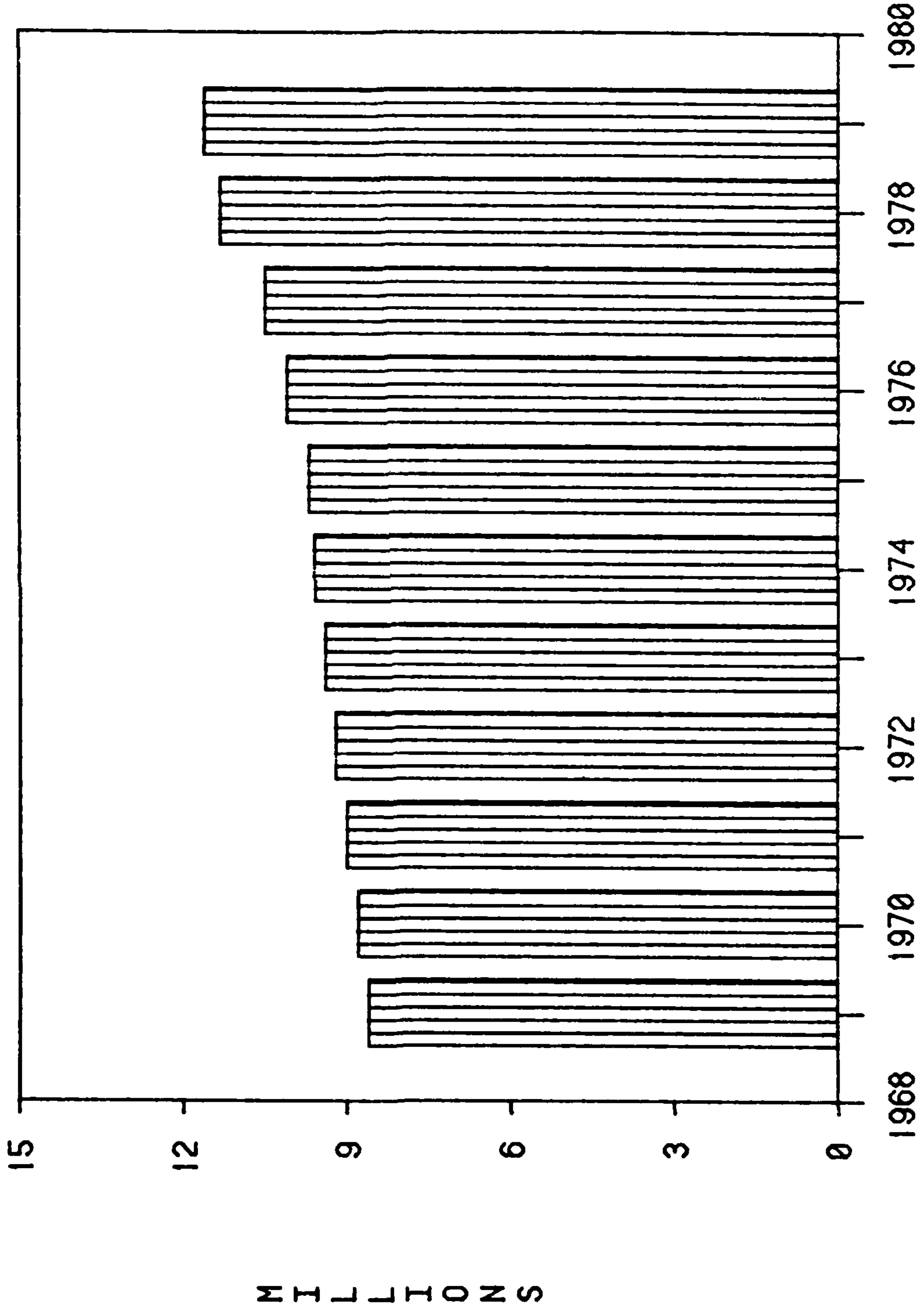
The New York Statewide Recreational Plan projects a 12 percent growth in boating activity in the Niagara Frontier (Erie and Niagara Counties) for the period 1975 to 2000, based on an analysis of the demand for boating by region within the State (NYSOPR, 1978). Using this growth rate, annual damages identified during 1982 have been adjusted to obtain an estimate of the annual damages for Project Year 1 (1990) and for the 10-year period to 2000 (Project Year 10). Further increases to the annual damages function were not made beyond Project Year 10 due to the lack of an adequate methodology.

Table B5 - Estimated Recreational Boats Owned in the U.S.

Year	Number of Boats
1969	8,646,000
1970	8,814,000
1971	8,981,000
1972	9,210,000
1973	9,435,000
1974	9,615,000
1975	9,740,000
1976	10,105,000
1977	10,515,000
1978	11,270,000
1979	21,625,000

SOURCE: Marex/National Association of Engine and Boat Manufacturers, 1979 Boating, '79. Joint Industry Publication. Chicago, IL.

FIGURE B-2 - ESTIMATED RECREATIONAL BOATS OWNED IN THE US



A 12 percent increase for the interval 1975 to 2000 yields an annual rate of change of 0.48 percent. Adjusting the $151,000 in boat/drift collision damages reported in 1982 to Project Year 1 (1990) by a rate of 0.48 percent compounded annually, yields $156,900 in damages. For the period 1990-2000 total annual damages increase to $164,600 or a growth of $7,700 in annual damages for this 10-year period. This increase was held constant for the remainder of the project life and is equal to an equivalent annual increase in damages of $5,600. The average annual equivalent growth in damages is added to the existing damages in Project Year 1 of $156,900, resulting in average annual boat/drift collision damages of $162,500. Table B6 provides a summary of boat/drift collision damages.

The navigational benefits category also includes damages to marina facilities and/or costs for debris removal at marina facilities that are avoided by implementation of the alternative plans. Based on available sources and survey results, damages and debris removal costs to facilities are held constant for the 50-year project life. While growth in boating facilities in the Buffalo area is expected during the project lifetime, where this growth may occur is not predictable at this time. Since damage or costs to facilities is dependent upon location within the study area, it is impossible to allocate regional growth to specific sites within the study area. Thus, drift removal costs or damages to marina facilities are considered to be an annual recurring cost held constant over the 50-year project life and equals $31,000.

Table B6 - Average Annual Boat/Drift Collision Damages

	$
Boat/Drift Collision Damages (1)	151,000
Annual Change in Demand for Boating	0.048%
Existing Average Annual Boat/Drift Collision Damages Project Year 1 (1990)	156,900
Projected Average Annual Boat/Drift Collison Damages Project Year 10 (2000)	164,600
10-Year Projected Growth in Damages	7,700
Average Annual Equivalent Factor 10 Years Straight Line Growth and 50-Year Project Life at 7-5/8 Percent	0.7276
Increase in Average Annual Boat/Drift Collison Damages	5,600
Total Estimated Average Annual Damages	162,500

(1) Adjusted for non-Respondents.

A third navigational benefits category consists of future costs avoided for replacement of drift containment systems presently in operation. Several devices such as air bubblers or air barrier systems have been installed at several large marinas along the Niagara River to prevent drift damage to their facilities. If the proposed alternatives are implemented, replacement of these systems would not have to occur. Based on a preliminary engineering and design evaluation, the average life expectancy for such a system, which primarily consists of an air compressor and underwater piping, would be approximately 25 years. Thus, these costs would reoccur once during a 50-year period and are therefore considered as a one-time cost which may be avoided after implementation of a plan of improvement. Future costs avoided are presented in Table B7.

Table B7 - Annual Replacement Costs for Drift Containment Systems

Expenditures for Drift Containment Systems (1)	$33,000
Present Worth Factor - Project Year 25 at 7-5/8 Percent	0.15928
Amortization Factor at 7-5/8 Percent	0.7823
Annual Replacement Costs for Drift Containment Systems	$400

(1) Estimated costs to replace or rehabilitate existing debris control systems presently in operation.

Total annual navigational damages and benefits are summarized in Table B8. It is assumed that debris damages and costs associated with removal are proportional to the amount of debris reduction as a result of plan implementation. Based on preliminary engineering analysis and previous research, damage reduction factors for each alternative plan have been developed and each plan has been associated with a unique damage reduction factor. The degree of damage reduction reflects the relative effectiveness and characteristics of each plan. These factors are then applied to the existing average annual navigational damages/costs to determine the total estimated annual navigational benefits for each alternative. The damage reduction factors are .70, .40, and .90 for Alternatives II, III, and IV respectively.

Table B8 - Average Annual Navigational Damages and Benefits Summary

Damages/Benefit Categories	Alternatives I: No-Action Plan	II: Continuous Removal	III: One-Time Removal	IV: One-Time Cleanup and Continuous Removal
		$	$	$
Total Estimated Average Annual Boat/Drift Collision	-	162,500	162,500	162,500
Average Annual Debris Removal Costs/Damages to Facilities	-	31,000	31,000	31,000
Annual Replacement Costs for Drift Containment Systems	-	-	-	400
Total Estimated Average Annual Navigational Damages	-	193,500	193,500	193,500
Damage Reduction Factors	-	0.70	0.40	0.90
Total Estimated Navigational Benefits	0	134,500	77,400	174,500

Future costs avoided are considered as a benefit category for Alternative IV only as this is the most effective alternative in terms of reducing the volume of debris within the study area. Thus, this alternative would eliminate the need for continued investments in air bubbler or air barrier (drift containment) systems. Since the volume of drift removed is not as great in Alternatives II and III, no future costs avoided benefits are taken for these plans, as marina operators would continue to require use of an air barrier or a similar type of drift containment system to alleviate drift problems at their facilities.

(2) Land Enhancement Benefits - The methodology and development of land enhancement benefits are documented in Appendix C, Real Estate. This analysis is based on the assumption that the value of shoreline sites to a potential user or commercial developer would be increased by the savings in site preparation and increased waterfront access. The method used was to determine the cost of removal of drift and debris sources and estimate what percentage of the expenditures at each site will contribute to the increase in the property value of that site.

Based on the real estate market evaluation analysis in Appendix C, estimated average annual land enhancement benefits for each alternative are presented in Table B9. Annual benefits are obtained by amortizing the expected increase in land values over the 50-year project life at the project interest rate of 7-5/8 percent to provide the average annual benefits for each alternative.

Table B9 - Land Enhancement Benefits

Benefit Categories	Alternatives Plans			
	I	II	III	IV
	No-Action Plan	Continuous Removal	One-Time Removal	One-Time Cleanup and Continuous Removal
		$	$	$
Land Enhancement (1)	-	1,400	512,900	514,300
Amortization Factor at at 7-5/8 Percent	-	.07825	.07825	.07825
Average Annual Land Enhancement Benefits	0	100	40,100	40,200

(1) Change in market value of affected property within the study area is based upon methodology and supporting documentation in Appendix C, Real Estate.

(3) Maintenance Costs Reduction Benefits - Information provided by the City of Buffalo Engineering Department and the Buffalo Sewer Authority documents that these local public agencies have incurred annual costs for drift removal. The U.S. Army Corps of Engineers, Buffalo District, also incurs annual maintenance and operation costs for snagging and clearing activities near the upstream lock gates of the Black Rock Lock. Minor amounts of material may also be removed from various locations within the ship canal. The 3-year average annual Federal costs for debris removal within the study area and the annual costs for local agencies are provided in Tables B10 and B11.

Based on preliminary engineering analysis and previous research maintenance costs reduction benefits result from the elimination of Federal maintenance costs for snagging and clearing at the entrance to the Black Rock Lock and the ship canal and drift removal costs for the City Engineering Department and the Buffalo Sewer Authority. Alternatives II and IV, which would implement continuous drift removal plans are assumed to eliminate these costs. However, Alternative III is a one-time cleanup of drift sources and would reduce drift removal costs by the expected amount of drift reduction. Based on a preliminary engineering analysis, 40 percent of the drift would be eliminated and therefore a 40 percent cost reduction is expected to occur. Maintenance costs reduction benefits for each alternative are summarized in Table B12.

Table B10 - Annual Federal Maintenance Costs for Snagging and Clearing

Cost Categories (1)	Fiscal Year 1980	Fiscal Year 1981	Fiscal Year 1982	Average Expenditures
	$	$	$	$
Equipment Costs	56,320	64,860	66,260	-
Labor Costs	34,380	26,660	41,220	-
Total Annual Costs	90,700	91,520	107,480	96,600
Total Annual Costs (May 1982 price levels)	109,570(2)	99,940(2)	107,480	106,000

(1) Reflects the Floating Plant and associated labor charges for removal of floating debris and related materials only.

(2) Based on ENR update factors for May 1980-1982 of 1.208 and May 1981-1982 of 1.092.

SOURCE: Construction and Operations Division, Plant Branch, Buffalo District, Corps of Engineers; Engineering News Record, March 1982 and May 1982.

Table B11 - Total Federal and Non-Federal Average Annual Maintenance Costs

Cost Categories	Average Annual Costs
	$
Non-Federal Agencies	61,000 (1)
Federal Costs	106,000
Total Annual Maintenance Costs	167,000

(1) Consists of removal of floating and submerged logs, tires, fish, and other floating debris collected at river outfall trash racks by the Buffalo Sewer Authority and city of Buffalo.

Table B12 - Average Annual Maintenanc Costs Reduction Benefits

Benefit Categories	I	II	III	IV
	ternative Plans			
	No-Action Plan	Continuous Removal	One-Time Removal	One-Time Cleanup and Continuous Removal
		$	$	$
Average Annual Maintenance Costs	-	167,000	167,000	167,000
Cost Reduction Factor	-	1.00	0.40	1.00
Total Estimated Average Maintenance Costs Reduction	0	167,000	66,800	167,000

(4) Employment Benefits - In labor market areas which have been designated as redevelopment areas, current planning guidance directs that project benefits shall be considered to be increased by the value of unemployed or underemployed local labor required by project implementation. Otherwise, it is assumed, such labor woulc not be utilized or would be underutilized. In order to achieve designation as a redevelopment area a region must meet the established criteria for "substantial and persistent" unemployment. Published standards for the designation of "substantial and persistent" unemployment areas may be found in the Water Resource Council Reference Handbook for FY 82.

The Buffalo SMSA (Niagara and Erie Counties) has experienced substantial high unemployment. Therefore a determination of eligibility for National Economic Development benefits from employment of previously unemployed labor resources was undertaken.

The evaluation criteria states that an area can be considered to have "substantial and persistent" unemployment when:

(a) The Secretary of Labor finds that the current rate of unemployment as determined by appropriate annual statistics for the most recent 12 consecutive months is 6 percent or more and has averaged at least 6 percent for the qualifying time periods specified in Table B13.

(b) The Secretary of Labor finds that the annual average rate of unemployment has been at least: (1) 50 percent above the national average for three of the preceding four calendar years, or (2) 75 percent above the national average for two of the preceding calendar years, or (3) 100 percent above the national average for one of the two preceding calendar years.

Eligibility determination is based on national unemployment rates for the relevant time periods as presented in Table B14. The current rate of

unemployment as of February 1982 for the Buffalo SMSA was 14.3 percent. The average annual rate of unemployment for the most recent 12 consecutive months for which data are available is 10 percent. Thus, the Buffalo SMSA meets the criteria for "substantial" unemployment as defined in paragraph (a) above, that is averaging at least 6 percent over a 5-year period.

Table B13 - Annual National Unemployment Rates and Percentage Categories

Year	National	50 Percent Above National Rate	75 Percent Above National Rate	100 Percent Above National Rate
1977	7.0	10.5	12.3	14.0
1978	6.0	9.0	10.5	12.0
1979	5.8	8.7	10.2	11.6
1980	7.1	10.7	12.4	14.2
1981	7.6	11.4	13.3	15.2

SOURCE: U.S. Bureau of Labor Statistics

Table B14 - Historical Unemployment Rates - Buffalo, NY

Year	Unemployment Rate (1) (Percent)
1977	9.3
1978	7.9
1979	7.3
1980	9.9
1981	9.6
5-Year Average	8.8

(1) Standard metropolitan statistical area consists of Erie and Niagara Counties and is considered to be an approximation for the local labor market.

SOURCE: U.S. Bureau of Labor Statistics

However, the Buffalo area does not meet the requirements for "persistent" unemployment as defined in paragraph (b) above. As can be seen by comparing the data in Tables B13 and B14 the annual SMSA rates for the period 1977 to 1981 are not at least 50 percent above the national rates for that period. Therefore, the Buffalo SMSA does not qualify as an eligible area for NED

employment benefits which would result from the employment of previously unemployed labor resources.

B3. SUMMARY OF THE ECONOMIC EVALUATION

The estimated average annual costs and benefits, the net benefits and the ratio of benefits to costs for each alternative plan are presented in Tables B15 and B16. Alternative III, the one-time removal of all drift sources is the only alternative plan with positive net benefits. Alternative II, the annual program for removal of drift in the project area, and Alternative IV, a combination of Alternatives II and III, are not economically feasible based on the preliminary analysis. Therefore, Alternative III is marginally feasible and further study of this alternative plan is warranted in the next stage of study.

A number of assumptions were required to complete this preliminary evaluation. Critical assumptions include the damage reduction factors associated with each plan and the change in real estate property values. Future studies should address these areas since the overall project feasibility is marginal. Further investigations of site specific economic or financial costs which have occurred within the study area should be conducted. Investigations of the public attitude towards recreational boating in light of the current debris problem within the study area should be considered. These studies should be based upon a survey of recreational boat owner/operators during the warm weather season.

Future studies should also be made of navigational damages and drift origination by harbor or river reach as certain sections of the study area may be accountable for a major portion of the navigational damages and drift accumulation. If this were true, major cleanup activities could be concentrated in those harbor reaches with the greatest amount of damages and/or drift accumulation and result in an optimization of the net benefits for the alternative plans. To determine where damages occurred, an extensive survey of recreational boat owners/operators would be required. Also, a more detailed inventory of the drift and debris present within the study area is required in order to determine the origination of drift by harbor or river reach.

Further study should also be made of the alternative energy sources as a result of disposal by resource recovery. While this is reflected in the reduction in disposal costs a minor optimization of benefits may result. This could be accomplished in the next stage of study by an investigation of the significance, if any, of the energy savings that result from disposal by energy resource recovery.

Table B15 - Average Annual Benefits Summary (1)

Benefit Categories	Alternative Plans I: No-Action Plan	II: Continuous Removal	III: One-Time Removal	IV: One-Time Cleanup and Continuous Removal
		$	$	$
Total Estimated Average Annual Navigation Benefits	-	134,500	77,400	174,500
Total Estimated Average Annual Maintenance Costs Reduction Benefits	-	167,000	66,800	167,000
Total Estimated Average Annual Land Enhancement Benefits	-	100	40,100	40,200
Total Estimated Average Annual Benefits	0	301,600	184,300	381,700

(1) Average Benefits based upon June 1982 price levels.

Table B16 - Benefits and Costs Summary

Benefit/Costs	Alternative Plans I: No-Action Plan	II: Continuous Removal	III: One-Time Removal	IV: One-Time Cleanup and Continuous Removal
		$	$	$
Total Estimated Average Annual Benefits	-	301,600	184,300	381,700
Total Average Annual Costs (1)	-	455,000	173,100	625,000
Net Benefits	-	-153,400	11,200	-243,300
Benefit/Cost Ratio	-	.66 to 1	1.06 to 1	.61 to 1

(1) Project costs reflect disposal based on energy resource recovery at Niagara Falls, NY.

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APPENDIX C

REAL ESTATE

BUFFALO NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX C

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BUFFALO NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX C

C1. DESCRIPTION OF PROJECT AREA

The project under consideration consists of the shorelines of the Niagara River from Niagara Falls, NY to Buffalo, NY and the Buffalo River from the Buffalo Harbor to the east side of the Seneca Street Bridge. The rivers are within Erie and Niagara Counties of New York State. Various sites along the shoreline with accumulations of drift and debris and abandoned portions of dock, fender or mooring structures are being identified for a one-time cleanup from the river.

The shoreline borders the communities of Niagara Falls, Grand Island, Wheatfield, North Tonawanda, Tonawanda, and Buffalo. The properties adjacent to the shoreline vary in zoning from heavy industry in Buffalo to a mixture of residential, commercial, and industrial in the outlying areas.

C2. VALUATION PROBLEM

The proposed shoreline cleanup is to be accomplished by boat and no land access or work area is planned at this stage. An investigation of any change in value of the land adjacent to the cleanup areas has been made and it has been determined that removal of dilapidated piers and other sources can have an effect on the riverfront property value. The cleanup will reduce the cost of site preparation or redevelopment by the ownership due to the prior removals and cleanup. This will make the property more marketable and desirable to a potential user. In general, the value of the shoreline sites to a potential user or developer would be increased by his saving in costs of site preparation and increased riverfront access. In some cases the removal of surrounding debris and its sources could also increase the value of the site.

There are no fixed standards by which to measure the effect of debris removal on surrounding sites, therefore the reduction in costs of future or subsequent usage as related to actual cleanup costs has been used in this estimate of the increase in value or enhancement of the sites adjacent to the debris removal areas.

C3. VALUATION ANALYSIS

The most reasonable method for estimating property enhancement in this study area is to determine the cost of removal of drift and debris sources and estimate what percentage of that cost will contribute to the increase of adjacent property values. This method of examining enhancement is considered in the same manner as a buyer in the real estate market judging the worth of a parcel of land which requires additional site preparation. The market will set the price of the site to be somewhere within the range of the value of the site before expenditure of the site costs and the value of the site plus

the costs expended will usually be reflected in the increase in value resulting from that expenditure.

Since the project estimates are to be broken down to a community or township basis, the cost estimates of removal used as a basis of value enhancement have been provided on this basis. The volume of debris and the cost of removal is based on the unit costs which will be provided by the Planning Division.

A market survey of sales of the various types of property (i.e., residential, commercial, industrial) in the study area was made to determine the value range within the local real estate markets. The present land uses were determined from existing zoning and land use maps of the communities involved and an inspection of various segments of shoreline.

An estimate of the present worth of the future benefit of the cleanup is estimated to be in the range of zero percent and 75 percent of cost expended for the cleanup.

In order to expedite the results of this study, it has been decided that a percentage will be established for each site which would represent the portion of the cost to be expended that contributes to the property enhancement. These percentages can then be applied to the cleanup costs estimates for the three methods of debris disposal being considered.

The percentage of enhancement was estimated after consideration was given to the type of debris (floating or onshore); the location of debris (open river, cove, or slip); the zoning and use of land adjacent to cleanup site; the type of structures removed (dock, fender, or pilings) and the location of the structure sites in relation to river access land usage.

The property enhancement expressed as a percentage of the one-time cleanup cost to remove the structures, debris, and drift was arrived at by considering the structures closest to the shore or onshore would contribute more heavily to the land enhancement and the enhancement would fall off the further away from the shoreline (similarly the navigational enhancement would be the opposite). The drift and debris contribution enhancement would be the greatest for the debris on the shore or riverbank and decrease rapidly for the sites that contain floatable or floating debris as it could be pushed away from the site by natural wind and wave movement, and it is a one-time cleanup. More weight was given to the drift trapped in slips or natural coves as natural movement would be restricted. (Navigational enhancement would receive a greater share or percentage of the cost example: raising of an offshore sunken vessel would have no impact on land enhancement, but 75 percent - 100 percent on potential enhancement.)

A list of the sited, grouped by town, and the percentages estimated for each site is shown on Table C1.

Table C1 - Estimate of Property Enhancement

Locality	Site Number	Type	Use or Zoning	Property Enhancement (Percentage of Cost Removal)
Niagara (Niagara River)	1	Building	Bus.	75
	2	Dock	Res.	40
Wheatfield (Niagara River)	3	Dock	Mfr.	40
City of North Tonawanda	4	Mooring Cluster	Mfr.	40
	5	Pilings	Mfr.	40
	6	Dock	Mfr.	40
Tonawanda (Niagara River)	7	Dock	Mfr.	40
City of Buffalo (Niagara River)	8	Dock	Mfr.	40
	Between 8 & 9	Drift - (Slip)	Mfr.	20
	9	Fender	Mfr.	50
	Between 9 & 10	Drift - (Cove)	Mfr.	20
	Between 9 & 10	Drift - (Float)	Mfr.	5
	10	Dock	Mfr.	40
	Between 10 & 11	Drift-A-Float	Mfr.	5
	Between 10 & 11	Drift-B-Float	Mfr.	5
	Between 10 & 11	Drift-C-Float	Mfr.	5
	Between 10 & 11	Drift-D-(Slip)	Mfr.	20
	V-1	Sunken Vessel	At Breakwater	0
City of Buffalo (Buffalo River)	11	Fenders	Mfr.	50
	12	Dock	Mfr.	40
City of Buffalo (Buffalo River)	13	Dock	Mfr.	40
	Between 13 & 14	Drift (Bank & Slip)	Mfr.	30
	14	Piling	Mfr.	40
	Between 14 & 15	Drift (Open)	Mfr.	5
	15	Dock	Mfr.	40
	Between 15 & 16	Drift (Open)	Mfr.	5
	Between 15 & 16	Drift (Bank& Slip)	Mfr.	30
	16	Pilings	Mfr.	40
	17	Dock Pilings	Mfr.	40
	Between 17 & 18	Drift-A-(Bank)	Mfr.	30
	Between 17 & 18	Drift-B-(Bank)	Mfr.	30
	Between 17 & 18	Drift-C-(Open)	Mfr.	5
	Between 17 & 18	Drift-D-(Bank)	Mfr.	30
	18	Fenders	Mfr.	40

Table C1 - Estimate of Property Enhancement (Cont'd)

Lo	Locality	Site Number	Type	Use or Zoning	Property Enhancement (Percentage of Cost Removal)
	City of Buffalo	Between 18 & 19	Drift-A-(Open)	Mfr.	5
		Between 18 & 19	Drift-B-(Open)	Mfr.	5
		19	Dock	Mfr.	40
		Between 19 & 20	Drift (Open)	Mfr.	5
		20	Piling & Drift	Mfr.	40
		Between 10 & 21	Drift (Open)	Mfr.	5
		21	Pilings	Mfr.	40
		22	Pilings	Mfr.	40
		23	Pilings	Mfr.	40
		24	Pilings	Mfr.	40
		25	Fenders	Mfr.	50
		26	Pilings	Mfr.	40
		27	Building & Pilings	Mfr.	75
		28	Pilings	Mfr.	40
		29	Pilings	Mfr.	40
		30	Moorings & Crib Wall	Mfr.	50
		31	Fenders	Mfr.	50
		32	Mooring	Mfr.	40
		Between 32 & 33	Drift (Bank)	Mfr.	30
		33	Pilings	Mfr.	40
		V-2	Sunken Vessel		0
		34	Pilings	Mfr.	40
		35	Dock	Mfr.	40
		36	Pilings	Mfr.	40
		Between 36 & 37	Drift (Open)	Mfr. (Dike)	0
		37	Dock & Mooring	Mfr.	40
		Between 37 & 38	Drift-A-(Open)	Mfr.	5
		Between 37 & 38	Drift-B-(Bank)	Mfr.	30
		38	Pilings	Mfr.	40
		Between 38 & 39	Drift-A-(Slip)	Mfr.	20
		Between 38 & 39	Drift-B-(Bank)	Mfr.	30
		Between 38 & 39	Drift-C-(Open)	Dike & Mfr.	0
		Between 38 & 39	Drift-D-(Cove)	Mfr.	20
		39	Retaining Wall Plans	Mfr.	50
		40	Pilings	Mfr.	40
		Between 40 & End	Drift (Bank)	Mfr.	30

C4. STATEMENT OF LIMITING CONDITIONS AND ASSUMPTIONS

In making the value estimate of the subject project, the following assumptions and limiting conditions are presented:

a. That merchantable fee simple titles, free of encumbrances, are vested in the ownerships of record.

b. That all data obtained from the township assessor records and local realtors used in compiling this report are considered reliable, but the appraiser does not guarantee their correctness.

c. That the estimated value is merely a rough estimate and does not constitute a formal appraisal report.

d. That exhibits attached to this report are solely for the purpose of assisting the reader to visualize and understand its contents and are not intended to be exact in scale or detail.

e. That no attempt has been made to render an opinion relative to title or status of easements or any other matter of a legal nature.

f. That I have no present or contemplated future interest in the property.

C5. CERTIFICATION

I hereby certify that I have carefully examined the properties described and that the estimates as developed in this report represent my unbiased judgment of the present Fair Market Value of the appraised subject only to assumptions and limiting conditions as specifically set forth herein.

Based on the information contained in this report, but not limited thereto the estimated Enhancement Value of the Project as of 19 November 1981, is in the amounts of: The percentage of enhancement by site and town as listed.

ROBERT M. STEFANSKI
Staff Appraiser
Real Estate Division, NCD

C6. COMPUTATIONS OF PRESENT WORTH OF THE FUTURE BENEFITS

The following tables and text present the computations and reasoning used in determining the Present Worth of the Future Benefits of the Property Enhancement for the alternative plans. These computations will be based upon Table C2, which is taken from Table A17, Summary of Quantities and Cost, p. 23 of the Cost Estimate, Appendix A, and Table C1, which is in the preceeding section, Estimate of Property Enhancement. The cost estimate was not broken up into individual sources as was the Estimate of Property Enhancement thus the quantities for the individual sites when applicable were taken directly off the inventory sheets.

In general the costs of removal at each site were multiplied by the percent of cost removal shown in Table C1, Estimate of Property Enhancement to obtain the present worth of the future benefits for property enhancement. Following is a summary of these calculations with brief explanations:

C7. PROPERTY ENHANCEMENT: NIAGARA

There are two sites in the Niagara section of the study area, these are Sites 1 and 2. The property enhancement for these two sites is 75 percent and 40 percent respectively from Table C1. The quantity of debris at each of these sites was taken from the inventory sheets and are shown on Table C3. The determination of the Present Worth of the Future Benefits for Niagara is calculated in Table C3. Also shown in Table C3 is the property enhancement due to removing the onshore debris and the dilapidated structure, the cost for these is shown on Table C2, and the percentage of the property enhancement is taken from Table C1, for similar type sources of drift. The remaining calculations for the Present Worth are carried out in a similar fashion.

Table C2 - Summary of Quantities and Costs

Unit	Source Type	Locality															
		Buffalo				Tonawanda				Wheatfield				Niagara			
		Federal		Non-Federal		Federal		Non-Federal		Federal		Non-Federal		Federal		Non-Federal	
		(cu ft)	($)	(cu ft)	($)	(cu ft)	($)	(cu ft)	($)	(cu ft)	($)	(cu ft)	($)	(cu ft)	($)	(cu ft)	($)
1	Dilapidated Structures																
	Marine			14,480	116,060							765	6,022			100	787
	Land			86,170	514,021												
	Structures Piles Pulled																
	Marine			16,520	74,261			1,400	6,093			1,400	6,094				
	Land			10,000	34,752												
	Structures Piles Cut																
	Marine			11,880	123,257			1,200	12,278			6,500	66,511				
	Land			12,250	93,776												
	Partially Dilapidated Structures Heavy																
	Marine			38,340,797	18,489,706												
	Land - Grain Mills																
2	Dilapidated Structures Light															1,100	18,487
	Marine																
	Land																
3	Derelict Vessels	12,000	78,902	6,000	39,451												
4	Onshore Debris	20,675	98,520	10,200	48,605					667	3,083	333	1,539	67	310	33	153
	Marine																
	Nonfloodable Marine			175	833							100	467			500	231
5	Floating Debris																
	Marine	2,043	18,827	1,007	9,280												
	Totals		196,249		19,544,002		0		18,371		3,083		80,628		310		19,598

Table C3 - Present Worth of Future Benefits; Niagara

Site Number	Cubic Feet (1)	Cost (2)	Property Enhancement: Percent of of Total Cost (3)	Present Worth of Future Benefits
1	800	13,400	.75	10,100
2	300	5,000	.40	2,000
Onshore Debris		500	.30	200
Dilapidated Structure		800	.40	300
Total	11,000	19,700		12,600

(1) Taken from the inventory sheets, which are available at the Buffalo District Office.

(2) Costs found by adding the cost of disposal of .82 to unit costs shown in Table A17, Appendix A.

(3) Property enhacement taken from Table C1.

C8. PROPERTY ENHANCEMENT: WHEATFIELD

Since there is only one structure in Wheatfield, take the total estimated cost from Table C2, and multiply it by the Property Enhancement factor found in Table C1, for Site 3. This calculation is shown below in Table C4.

Table C4 - Present Worth of the Future Benefits; Wheatfiel

Total Cost	Property Enhancement Percent of Total Cost	Present Worth of Future Benefits
$83,711	.4	$33,500

C9. PROPERTY ENHANCEMENT: CITY OF NORTH TONOWANDA

From Table C1, it can be seen that all of the Sites 4, 5, and 6 have property enhancement factors of 40 percent. Thus, to determine the Present Worth of the Future Benefits, multiply this factor by the total cost of removing sources of drift as found in Table C2. This calculation is shown in Table C5 below.

Table C5 - Present Worth of the Future Benefits; City of North Tonawanda

Total Cost	Property Enhancement Percent of Total Cost	Present Worth of Future Benefits
$18,371	.4	$7,300

C10. PROPERTY ENHANCEMENT: TOWN OF TONAWANDA

There is one site in the Town of Tonawanda, this is Site No. 7, from the inventory it was found that this site has 1,200 cubic feet of debris, multiplying this quantity by the unit cost which is (3.53 + .82) yields $5,335. This cost was included in the cost estimate for the city of Buffalo. To determine the Present Worth of the Future Benefits, multiply this by the factor for Site No. 7, from Table C1. This is shown in Table C6, below:

Table C6 - Present Worth of the Future Benefits; Town of Tonawanda

Total Cost	Property Enhancement Percent of Total Cost	Present Worth of Future Benefits
$5,335	.4	$2,100

C11. PROPERTY ENHANCEMENT: BUFFALO

To determine the Present Worth of the Future Benefits it was necessary to determine the property enhancement for the type of source, and multiply this factor by cost of removal. For instance in Buffalo all the docks and dilapidated heavy structures have a 40 percent property enhancement factor except for a few individual cases which were 50 percent or 75 percent (see Table C1). To determine the Present Worth of the Future Benefits, the sites that were the exceptions were subtracted out and multiplied by the appropriate property enhancement factors (50 percent or 75 percent, etc.). Then the remaining sources were multiplied by the 40 percent property enhancement factor. These calculations are shown in Table C7.

Table C7 - Determination of Present Worth of Future Benefits for Dilapidated Structures, Marine; Buffalo

Source Type	Structure Numbers (1)	Quantity Cubic Feet (2)	Property Enhancement Percent of Total Cost	Total Quantities
Marine		14,480		
	9	-200	.5	100
	11	-6,500	.5	3,250
	25	-100	.5	50
	39	-170	.5	85
		7,510	.4	3,004
Total				6,489

(1) *Taken from Table C2.*

(2) From Table A17, Appendix A, Cost Estimate, and individual quantities at each site are from the inventory.

Then these quantities that were determined were added together and multiplied by the unit cost of removal and disposal as shown below. Thus, the Present Worth of the Future Benefits is $52,010 for dilapidated structures, , Buffalo.

6,489 X (7.05 + .9652) = $52,010 (7.05 + .9652) is the unit cost of removal and disposal for this type of work, from Table A17, Cost Estimate, Appendix A.

The remaining Present Worth of the Future Benefits for the different source types for Buffalo is summarized in Table C8, below.

Table C8 - Present Worth of Future Benefits; Buffalo

Type of Drift Source	Present Worth of the Future Benefits
	$
Dilapidated Structures	
Marine	52,010
Land	211,335
Structure Piles	
Pulled	41,470
Cut	109,396
Derelict Vessels	0
Onshore Debris	43,205
Floating Debris	1,408
Total	457,400

C12. PROPERTY ENCHANCEMENT: SUMMARY

Table C9 is a summary of the Present Worth of the Future Benefits for the study area. This Table summarizes Tables C3, C4,C5, C6 and C8.

Table C9 - Summary of Present Worth of Future Benefits

Locality	Present Worth of the Future Benefits
	$
Niagara Falls	12,600
Wheatfield	33,500
City of North Tonawanda	7,300
Town of Tonawanda	2,100
Buffalo	457,400
Total	512,900

THE BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL STUDY

BUFFALO, NEW YORK

APPENDIX D

ENVIRONMENTAL ASSESSMENT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

October 1982

D1. SUMMARY

This Environmental Assessment of the proposed alternatives for the Buffalo Harbor Drift and Debris Removal Study includes consideration of the need for the project, the proposed alternatives, and the possible effects of these alternatives on the environment.

The purpose of this study, which is included under the Buffalo Harbor Navigation Study authorization, is to examine the feasibility of various alternatives for drift and debris collection, removal, and disposal, including the possibility of eliminating some sources of debris. Drift and debris removal would eliminate a portion of this navigational hazard resulting in an estimated $151,000 in reported craft damages, approximately $31,000 in facilities damages; $33,000 in drift containment system expenditures and debris removal costs, as well as removing what many consider an eyesore.

The study area includes 40 sites on the waterfront within the cities of Niagara Falls, Buffalo, and Tonawanda and the towns of North Tonawanda and Wheatfield.

Four alternatives for collection and removal of drift and debris were considered: No Federal Action (I), Continuous Removal of Drift (II), One Time Cleanup of Sources of Drift and Debris (III), and a combination alternative, One Time Cleanup and Continous Removal of Drift and Debris (IV). Also considered were three methods of drift and debris disposal: Burning in a Mobile Total Combustion Unit (a), Hooker Chemical Energy Recovery (b), and Landfill Site (c).

No significant adverse impacts were discovered during the evaluation of the proposed plans. Alternative IV - One Time Cleanup and Continuous Removal of Drift and Debris has the most adverse and the most beneficial impacts. Most adverse effects would occur during the actual removal and disposal of the debris. The No Action Alternative (I) has the least adverse and the least beneficial impacts. Disposal method b., Hooker Chemical Energy Recovery, is the only disposal method with benefits, as it would be effectively recycling the debris. This method and c., Landfill Disposal require more truck transits than disposal method a. Disposal at Hooker could result in some increase in the amount of pollutants released, but the facility is required to be equipped to meet all effluent release restrictions. The total combustion unit would have the least environmental impact, but creates no benefits.

The most feasible plan is Alternative III, One Time Cleanup of Sources of Drift which will reduce the amount of drift by 40 percent. Alternative III is the only plan which is economically feasible. It has no significant adverse impact on the environment and has the same beneficial aspects as the other alternatives, to varying degrees.

The Hooker Chemical "Energy from Waste" Plant was chosen as the most feasible disposal method as it has no significant adverse impacts and effectively recycles the drift and debris materials recovered. This method is the least expensive of the three alternative disposal methods.

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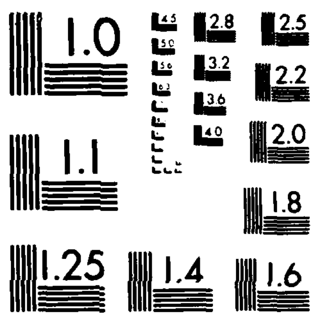

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This Environmental Assessment and a Finding of No Significant Impact (FONSI) is being coordinated at this time in conjunction with the Buffalo Harbor Study Stage II documentation to expedite potential implementation of proposed Drift and Debris Removal measures only.

As stated in the Buffalo Harbor Study main report (see Page 102), findings of this and other harbor-related studies and/or developments (i.e. Buffalo Waterfront Planning Board Studies, Creation of Offshore Island study, NFTA Section 107 Small-Boat Harbor study, New Marina Development (Cargill area) study, etc.) will be considered and any cumulative impacts incorporated into the Final Buffalo Harbor Navigation Improvement Feasibility Study report and Environmental Impact Statement (EIS).

Public comments are solicited, and required coordination for this stage of the study will be completed with the distribution of this report. For further information, contact:

Tod Smith
Environmental Resources Branch
U.S. Army Corps of Engineers
Buffalo, New York 14207
(716) 876-5454 Ext. 2171

ENVIRONMENTAL ASSESSMENT FOR
THE BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL STUDY

APPENDIX D

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D2. NEED FOR THE PROPOSED ACTION

a. Background.

(1) Study Authority - Authorization for this report is included under the authority for the Buffalo Harbor Study which reads:

> "Resolved by the Committee on Public Works and Transportation of the House of Representatives, United States. That the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Buffalo Harbor, New York, published as House Document No. 451, 87th Congress, Second Session and other pertinent reports, with a view to determining whether any modification to the recommendations contained therein are advisable at the present time and to determine the feasibility of navigation improvements to support increased or changing commercial activity and attendant facilities, including but not limited to bulk commodity transshipment facilities and modifications to realign the Buffalo River, New York, to accommodate passage and safe navigation of modern and larger ships operating on the Great Lakes and to make recommendations in a report to be submitted to the Congress."

Orginally this study was authorized by the Committee on Public Works of the House of Representatives in the following resolution adopted 15 August 1961.

> "Resolved by the Committee on Public Works of the House of Representatives, United States, That the board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports heretofore submitted on Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor, New York, and Niagara River, New York with a view to determining the advisability of establishing a separate project for the collection and removal of drift in the channels and tributary waterways."

The report that resulted from this authorization was the "REVIEW REPORT ON BUFFALO HARBOR, NY, BLACK ROCK CHANNEL AND TONAWANDA HARBOR, NY, NIAGARA RIVER, NY, AND TRIBUTARY WATERWAYS FOR COLLECTION AND REMOVAL OF DRIFT." The report, the only prior report that specifically dealt with drift and debris, recommended that a project be established for the collection, removal, and disposal of drift in the study area. However, it was determined at that time that there was no Federal interest in the project. In subsequent years similar studies have been undertaken by the Corps in other parts of the country that resulted in Corps projects with favorable cost benefit ratios. Based on these developments, the Buffalo District received approval to reactivate the Drift and Debris Study as an Appendix to and under the authority of the Buffalo Harbor Study. For other studies done within the project area, refer to Table 1 of the Main Report.

(2) Study Purpose and Scope - The purpose of this study is to determine the feasibility of a project for the collection, removal, and disposal of drift from the study area (indicated below). The report will also determine

the feasibility of eliminating the sources of drift, such as dilapidated shore front structures, loose onshore debris, and derelict (wrecked) vessels.

The study area includes; the Buffalo Outer Harbor, the Buffalo Ship Canal, the Buffalo River - approximately 1,500 feet upstream of the upstream limit of the Federal Project, the Tonawanda Channel of the Niagara River up to the end of the channel at the city of Niagara Falls, and all other areas in between as shown on Plate 1 and Figure 1 of the Main Report. The following communities are adjacent to the study area (from North to South); city of Niagara Falls, the town of Wheatfield, city of North Tonawanda, city of Tonawanda, Town of Tonawanda, city of Buffalo, and the city of Lackawanna, (see Plates 2-7 in the Main Report). The Preliminary Feasibility Report identifies, inventories, and presents feasible alternative solutions to the drift and debris problems of the study area.

b. Problem Identification.

Floating drift in the study area is a menance to small-boat navigation. Great numbers of small craft make use of the Buffalo Outer Harbor, Lake Erie, and the Niagara River. The boat operators must exercise care in navigating to avoid striking floating drift. The drift is most prevalent in the early spring following the winter thaw and during the summer following severe rain and wind storms. The greatest difficulty is experienced at night or during reduced visibility conditions when the drift is difficult to see. Large commercial vessels experience little or no difficulty with drift because of their size and construction. In addition to difficulties to navigation, other problems caused by drift and drift sources are: the unpleasant aesthetic effect of a shorefront cluttered with debris, decaying marine structures, and abandoned vessels; the hindrance to utilization of the shorefront for commercial and recreational purposes; the interferance with the operation of the Black Rock Lock; the expense of debris containment systems; and the clogging of storm sewer outfall chambers.

D3. EXISTING CONDITIONS

a. General.

For any proposed project, public law and Federal regulations require that relevant existing conditions and probable future conditions without a Federal project be identified. The law requires that the feasible alternatives be assessed for biological, social, and economic effects. The effects may be beneficial or adverse, significant or not significant. Significance may indicate quantitatively large change, qualitatively important change, or may merely suggest change the planner feels will be a matter of contention.

The parameters used to identify these impacts will be described briefly in this section. Although many will not be affected significantly by the proposed project, they are included to give the reader an overview of the area.

Based on the information available and a survey of recent areawide trends, the project will not have any significant and long-term adverse affects on the region. Short-term adverse effects may occur during the actual collection, removal, and disposal of the drift and debris. It is always possible that some unforseen impact will become apparent during the course of the planning process. Some potential project area effects have been identified and are discussed in Environmental Effects of the Proposed Plans. None of these are anticipated to be significant. Beneficial as well as adverse impacts are listed in Section V.

A brief summary of area characteristics (D3c.) and possible future conditions (D5a.1) is included to describe the Erie-Niagara area; i.e., the Buffalo SMSA (Standard Metropolitan Statistical Area). See Plate D1, Appendix a of the Environmental Assessment. As the vast majority of sites (see the Description of Drift and Debris Locations, Table D1) are located within the city of Buffalo - a corresponding amount of attention will be given to conditions within the city. More detailed information is available from the prior reports and other sources listed in the Bibliography.

b. Drift and Debris Description.

There are 10 types of drift and debris: buildings, docks, mooring clusters, pilings, drift, fenders, cribwalls, planking, actual drift, vessels, and miscellaneous. Wood or other floating material accounts for most of the drift and debris, occuring most frequently - 30 times among the various sites, pilings were second with 19 occurences, docks with 11, fenders and mooring clusters accounting for five each, two vessels and two buildings. The rest had only one occurence each. Thirty-five structures are dilapidated. These are primarily pilings and docks. There are 22 drift sites and five partially dilapidated structures.[1] (For more details on sites, see the Main Report and Table D1 of this Appendix).

The city of Buffalo has the most drift and debris sites by far, approximately 57. North Tonawanda has three, Niagara Falls has two, and the Town of Tonawanda and Wheatfield have two each.

The debris is also broken into the categories of floating debris, loose onshore debris (floatable and nonfloatable), light waterfront structures, heavy waterfront structures, and wrecked vessels. For specific amounts and a site-by-site breakdown of the drift and debris, see Table D1, page D-4. For site locations see Plates 2-7 in the Main Report.

[1] A partially dilapitated structure is one that is in disrepair, and is a source of drift, but can be repaired. Whereas a dilapitated structure is fallen into a state of ruin or decay that is considered more practicable to remove entirely than repair.

Table D1 - Descriptions of Drift and Debris Locations*

Plate No.	Structure Number	Description	Type	Location
1	1	Boathouse at Coast Guard Auxiliary	Building	City of Niag Falls
	2	Docks for Coast Guard Auxiliary	Dock	City of Niag Falls
2	3	Abandoned Dock at Town Line	Dock	Town of Wheatfield
	4	Mooring Cluster at Kooper's Inc.	Mooring Cluster	City of N Tonawanda
	5	Piling at North Tonawanda's Firemen's Park	Piling	City of N Tonawanda
	6	Abandoned Dock at R.T. Jones Lumber	Dock	City of N Tonawanda
3	7	Texaco Dock Adjacent to Huntley Plant	Dock	Town of Tonawanda
4	8	Old Dock at Industrial Molasses	Dock	City of Buffalo
	8/9	Drift at Rich Marina Slip	Drift	City of Buffalo
	9	Boathouse Protection at Rich Marina	Fender	City of Buffalo
	9/10	Drift at International RR Bridge	Drift	City of Buffalo
	9/10	Drift Near Mouth of Scajaquada Creek	Drift	City of Buffalo
	10	Old Dock at Collin's Marine	Dock	City of Buffalo
	10/11	Drift Across from Schaeffer Brewing and Mentholatum	Drift	City of Buffalo
	10/11	Drift from Ferry Street to Peace Bridge (right bank)	Drift	City of Buffalo
	10/11	Drift from Ferry Street to Peace Bridge (left bank)	Drift	City of Buffalo
	10/11	Drift from Day's Point to Buffalo Yacht Club	Drift	City of Buffalo
	V-1	Sunken Steel Vessel Next to Bird Isle Pier	Steel Vessel	City of Buffalo

* Sta = station.

Table D1 - Descriptions of Drift and Debris Locations (Cont'd)

Plate No.	Structure Number	Description	Type	Location
5	11	Deteriorated Fenders at DL&W; Sta 511+135 to 522+00	Fenders	City of Buffalo
	12	Wood Pile and Timber at Michigan Avenue Bridge; Sta 528+50	Piling	City of Buffalo
	13	Old New York City Railroad Dock near Michigan Avenue Bridge; Sta 529+50 to 547+50	Dock	City of Buffalo
	13/14	Drift in the Slip Adjacent to Ohio Street; Sta 551+00	Drift	City of Buffalo
	14	Piling Adjacent to Upstream End of New York City Railroad Dock; Sta 547+50 to 548+00	Piling	City of Buffalo
	14/15	Drift Upstream of Ohio Street Slip; Sta 552+00	Drift	City of Buffalo
	15	Piling in Front of Great Lakes Fiber Products; Sta 561+00 to 563+00	Piling	City of Buffalo
	15/16	Drift Adjacent to Upstream End of Great Lakes Fiber; Sta 561+00 to 563+25	Drift	
	15/16	Drift in Slip at the Foot of Hamburg Street; Sta 592+00 to 593+00	Drift	City of Buffalo
	16	Former Docks and Mooring Clusters for Great Lakes Dredge and Dock; Sta 615+00 to 640+00	Dock	City of Buffalo
6	17	Abandoned Pier, Piling Just Upstream of 1st Conrail Bridge; Sta 687+00	Piling	City of Buffalo
	17/18	Drift From Foot of Smith Street to Twin Railroad Bridges; Sta 694+00 to 760+00	Drift	City of Buffalo
	17/18	Drift in an Area Just North of Twin Railroad Bridges; Sta 710+00 to 752+00	Drift	City of Buffalo

Table D1 - Descriptions of Drift and Debris Locations (Cont'd)

Plate No.	Structure Number	Description	Type	Location
	17/18	Drift Between Lift Bridge at Republic Steel and National Aniline 749+00 to 752+00	Drift	City of Buffalo
	17/18	Drift from Bend in River North of South Park to Foot of Babcock Street; Sta 767+00 to 774+00	Drift	City of Buffalo
	18	Deteriorated Fenders at Mobil Oil Dock; Sta 774+00 to 789+00	Fender	City of Buffalo
	18/19	Drift Upstream of the End of Commercial Navigation; Sta 789+00	Drift	City of Buffalo
	18/19	Drift Upstream of the End of Commercial Navigation; Sta 789+00	Drift	City of Buffalo
	18/19	Drift Between South Park Bridge and Republic Steel; Sta 758+00 to 749+25	Drift	City of Buffalo
	19	Abandoned Dock Just Upstream of the Twin Railroad Bridges; Sta 716+00 to 710+00	Dock	City of Buffalo
5	19/20	Drift Located Between Conrail Bridge and Concrete Central; Sta 685+00 to 672+00	Drift	City of Buffalo
	20	Old Piling and Drift Immediately Downstream of the Abandoned Concrete Central; Sta 661+00 to 651+00	Drift and Piling	City of Buffalo
	20/21	Drift Alongshore Upstream of the Abandoned Cargill Superior Elevator; Sta 651+00 to 643+00	Drift	City of Buffalo
	21	Old Piling and Mooring Cluster Alongside the Downstream End of the Abandoned Cargill Superior Elevator; Sta 635+25 to 634+00	Piling and Mooring Cluster	City of Buffalo
	22	Old Piling Immediately Downstream of the Abandoned Cargill Superior Elevator; Sta 634+00 to 632+00	Piling	City of Buffalo

Table D1 - Descriptions of Drift and Debris Locations (Cont'd)

Plate No.	Structure Number	Description	Type	Location
	23	Old Piling Immediately Upstream of Abandoned Marine A Elevator; Sta 609+50 to 607+50	Piling	City of Buffalo
	24	Old Piling Immediately Downstream of the Abandoned Marine A Elevator; Sta 604+00 to 603+50	Piling	City of Buffalo
5	25	Deteriorated Fenders Along the Northside of Int'l Multifoods; Sta 591+00 to 590+00	Fenders	City of Buffalo
	26	Old Piling Between Huron Cement and the Abandoned Ganson Street Ware-House; Sta 568+00 to 563+50	Piling	City of Buffalo
	27	Old Piling in Front of the Abandoned Ganson Street Warehouse; Sta 558+00 to 548+00	Building and Piling	City of Buffalo
	28	Old Dock Piling Between the Agway Site and the Schaefer Waterfront Elevator; Sta 532+00 to 531+00	Piling	City of Buffalo
	29	Old Piling at Confluence of Buffalo Ship Canal and Buffalo River; Sta 804+00	Piling and Misc.	City of Buffalo
	30	Mooring Clusters and Deteriorated Crib Wall Between General Mills and Pillsbury; Sta 828+50 to 818+00	Mooring Clusters and Crib Wall	City of Buffalo
	31	Drift and Deteriorated Fender at Pillsbury Dock; Sta 843+00 to 829+00	Fender	City of Buffalo
	32	Old Mooring Cluster Near the End of Federal Project; Sta 854+00	Mooring Cluster	City of Buffalo
	32/33	Discarded Railroad Ties Located Near the Middle of Conrail's Burrows Yard	Drift	City of Buffalo
	33	Deteriorated Piling Located Near The Middle of Conrail's Burrows Yard	Piling	City of Buffalo

Table D1 - Descriptions of Drift and Debris Locations (Cont'd)

Plate No.	Structure Number	Description	Type	Location
	V-2	Sunken Wood Vessel at the End of the Federal Project; Sta 854+51	Wood Vessel	City of Buffalo
	34	Old Piling Along the Front of the Sand Products Facility; Sta 854+50 to 849+50	Piling	City of Buffalo
	35	Deteriorated Railroad Loading Dock at Upstream End of RCR Marina; Sta 830+75 to 830+00	Dock	City of Buffalo
	36	Old Piling and Planking between the Abandoned Connecting Terminals Elevator and the Skyway; Sta 808+00 to 803+50	Piling	City of Buffalo
	36/37	Drift Along the Lakeside Area Between the Coast Guard Base and the end of the Times Beach Dock; Sta 40+00	Drift	City of Buffalo
	37	Abandoned Dock With Mooring Clusters Adjacent to International Salt Company; Sta 46+00	Dock and Mooring Cluster	City of Buffalo
	37/38	Drift Between Seaway Pier II and Allen Boat Company Slip; Sta 59+000 to 76+70 and 101+00 to 110+00	Drift	City of Buffalo
	37/38	Drift Between Allen Boat Company Slip and NFTA Terminal; Sta 112+00 to 121+00	Drift	City of Buffalo
5	38	Old Piling at the Southwest Corner of the Freezer Queen Dock; Sta 141+50	Piling	City of Buffalo
	38/39	Drift in Slip Between NFTA and Freezer Queen Foods; Sta 138+00	Drift	City of Buffalo
	38/39	Drift on Bank in Front of Jet Ski; Sta 145+00 to 147+00	Drift	City of Buffalo
	38/39	Drift Along the NFTA Small Boat Harbor Dike (Including Disposal Area); Sta 151+00 to 178+00	Drift	City of Buffalo

Table D1 - Descriptions of Drift and Debris Locations (Cont'd)

Plate No.	Structure Number	Description	Type	Location
	38/39	Drift Between Disposal Area and Post Elevator; Sta 178+00 to Sta 192+00	Drift	City of Buffalo
	39	Deteriorated Retaining Wall on Northside of Abandoned Cargill Post Elevator; Sta 192+00	Planking	City of Buffalo
	40	Dilapidated Mooring Cluster on NE Corner of Abandoned Cargill Post Elevator; Sta 194+50	Piling	City of Buffalo
	40/END	Drift on Lakeside of Independent Cement; Sta 209+00 to 213+50	Drift	City of Buffalo

c. Natural and Human Environment and Cultural Resources.

Air Quality - The project area lies within a heavily developed area with numerous industries such as steel mills, grain milling, chemical, production and trucking companies, all of which have varying degrees of impact on air quality. In addition, in 1978 Erie County contravened more air quality standards than any other area in New York State (Gulf South Research Institute, 1981).

The New York State Department of Environmental Conservation (NYSDEC) air quality classification for the area within their project is designated Level IV - except for the shoreline of Grand Island which is designated Level III. Level IV is indicative of densely populated, primarily commercial office buildings, department stores, and industries in large metropolitan complexes or areas of heavy industry. The Level III classification is similar to Level IV except that industry is lighter, development sparser, and commercial establishments are more limited. (The classifications above are found in Title 6, Official Compilation of Codes, Rules, and Regulations of the State of New York, Subchapter A of Chapter III, Environmental Conservation Law, Air Resources.)

Water Quality - The Buffalo River and Buffalo Harbor area have historically been polluted by many point and nonpoint sources. Conversely, the Niagara River was considered to be relatively clean and pollution free. However, this may not be the case. Recent Canadian investigations - all data not available - seem to indicate there may be a number of toxins (e.g., pesticides) present in the Niagara River which could have an effect on the rivers water quality.

The New York State (NYS) Water Classification System is based on potential use of the water, with consideration given to existing land use practices. The Buffalo River within this project - including the Buffalo Ship Canal - are classified as Class "D" water. The North and South entrance channel of the harbor are Class "C" water and the outer harbor is classified as "B" water. Water in Lake Erie and the Niagara River are classified "A Special." "Special" indicating that the waters are used as an International Boundary according to the U.S. and Canadian Treaty of 1909. A further description of classification A, B, C, and D are provided below:

Class	Best Usage
A	Source of water supply for drinking, culinary or food processing purposes, and any other usages.
B	Primary contact recreation and any other use except as a source of water supply for drinking, culinary or food processing purposes.
C	Suitable for fishing and all other uses except as a source of water supply for drinking, culinary or food processing purposes, and primary contact recreation.
D	These waters are suitable for secondary contact recreation, but due to such natural conditions as intermittency of flow, water conditions not conductive to propagation of game fishery or streambed conditions, the waters will not support the propagation of fish.

(Title 6, Official Compilation of Codes, Rules, and Regulations of the State of New York, Chapter X, Division of Water Resources.)

Wetlands - There are approximately 120 acres of wetlands in the U.S. portion of the Niagara River, and a very limited number of wetland acreage within the Buffalo Harbor and River area. (IJC: 1981). The major types of wetland being the "lake-connected" inland type which is represented by the presence of a barrier beach or ridge which restricts the wetland outlet to the supplying water body and provides protection to the wetland from wave action and disturbances.

Vegetation - The highly commercial and industrial nature of the Buffalo River and Harbor area have effected the aquatic vegetation of the area. A variety of aquatic vegetation including water celery, water milfoil, water stargrass, waterweed, and other pondweeds can still be found throughout the area. The commercialization of the area has limited terrestrial vegetation to usually narrow strips of riparian vegetation, which is composed of various trees and shrubs of the Salix Genus (willow), sumac, aspen, boxelder, dogwood, and numerous common herbaceous forbs and grasses.

The Niagara River shoreline is also quite developed in certain areas, but does have wetlands and local strip parks not found elsewhere in the project area. The Niagara River does have extensive beds of aquatic vegetation in various shallow bays and shoal areas mainly consisting of pondweeds (Potamogeton) and wild celery (Vallisneria americana). (IJC: 1981)

Fishery - The fishery of the Buffalo River is comprised mainly of "trash" fish (e.g., carp, suckers, bullheads, goldfish) and some forage fish such as spotted and emerald shiners and small quantities of panfish (e.g., pumpkin seeds). High summer temperatures, low populations of aquatic and riparian vegetation, combined with high levels of pollution, low oxygen, and continual disturbances from yearly maintenance dredging and commercial ship traffic, severely limit fish spawning and reproductive success within the Buffalo River.

The Buffalo Harbor area shows improved water quality, increased substrate diversity, lower turbidity, and better oxygenation than the Buffalo River, and this is reflected accordingly in the fish population present. Annual fish residents include yellow perch, rock bass, centrarchids, and some small mouth and large mouth bass. In addition, seasonal residents include game fish such as occasional salmonids, pike, walleye, and muskellunge. The aforementioned improved physical conditions are also reflected in an increase of ichthyoplankton recorded in 1981 by SUNY at Brockport studies in the Buffalo Harbor area, further indicating an improvement of fish habitat and reproductive success over the Buffalo River.

The upper Niagara River supports a diverse warmwater recreational fishery which includes smallmouth and largemouth bass, yellow perch, muskellunge, and northern pike. Many of these species are known to spawn throughout various areas of the river. The nearshore zone of the river supports a bait fishery which is of some local economic value. (IJC: 1981) Additionally, a cold water fishery exists in the river as well, which consists of stocked, brown and rainbow trout, coho, and chinook salmon.

Wildlife - Terrestrial habitat within the Buffalo Harbor and River area is greatly reduced and altered by commercial and industrial development. There are a few isolated areas such as Times Beach, Tift Farm, and some open field areas along the Buffalo River, that support populations of pheasants, rabbits, passerine birds, and some nesting waterfowl and various species of rodents. However, the Outer Harbor area is extensively utilized throughout the year by shorebirds, gulls, and waterfowl for feeding and nesting. There is also a tern nesting colony located adjacent to the north breakwater in the Outer Harbor area.

A recent survey of the Buffalo Harbor and River area indicated that few species of amphibians and reptiles were found. Species included, leopard frogs, snapping turtles, painted turtle, and garter snakes. (SUNY Brockport: 1982)

The Niagara River contains more extensive riparian vegetation and wetlands than the Buffalo Harbor and River area. This increase in habitat (wetlands) benefits small mammals and provides the aquatic - shallow and calmer - habitat necessary to support more potential variety of amphibians and

reptiles. Also, the Niagara River supports extensive waterfowl population. As many as 25,000 waterfowl have occupied the Niagara River, especially during the winter months - with the merganser being the most abundant wintering species (IJC: 1981).

Endangered Species - Under Section 7 of the Endangered Species Act of 1973, consultation with U. S. Fish and Wildlife was instituted on 11 August 1980. Fish and Wildlife Service responded by indicating that except for occasional transient individuals, no Federally listed or proposed endangered species under their jurisdiction are known to exist in the study area. Also, a biological survey of the Buffalo Harbor and River area (1982) showed no New York State protected or endangered plant or resident animal species present within the proposed project area. However, personnel from SUNY Brockport, while performing biological field studies for the Buffalo District on 9 October 1981 and again on 8 November 1981, observed a peregrine falcon (Falco peregrinus) in the vicinity of an abandoned concrete grain elevator adjacent to the foot of Smith Street, Buffalo, NY. The falcon was observed stooping on a hooded merganser on 8 November 1981. The field crew did not find evidence of roosting in the area, but did notice the disappearance of resident house sparrows and starlings during the summer sampling periods from the grain elevator and adjacent open field.

Wild and Scenic Rivers - In accordance with the National Wild and Scenic Rivers Act, Public Law 90-542, the final list of rivers identified as meeting the criteria for eligibility dated January 1981 was consulted. Neither the Niagara River nor the Buffalo River are classified as wild or scenic.

Prime and Unique Farmlands - There are some small isolated areas of prime and unique farmlands that abut the Niagara River within the project area. These areas are located in Niagara County near the North Grand Island Bridge and along the east shore of Grand Island, Erie County, NY.

Benthos - Surveys in 1970 showed the Buffalo River benthic population to be mainly comprised of the order Pleisophora (sic) with sludge worms being the dominant form present. However, observations made in 1972 showed an increase in variety with nematodes and leeches being present. These species are more typical of less polluted environments than the forms found ' previous years. (Sweeny and Merckel: 1972).

A 1977 benthic study of Buffalo Harbor showed the family Chironomidae was the most diverse group followed by Tubificidae and Gastropoda. However, the most frequently occurring species was the snail Valvata tricarinata which accounted for approximately 14 percent of the total population within the area studied. This species was followed by the sludge worm, Limnodrilus - hoffmeisteri and the clam Pisidium sp., and the bloodworm Procladius sp. which make up approximately 7 percent of the population. This data and previous work done by Great Lakes Lab (1975) indicated that there were no rare and endangered species present. There were some (species) though, that were uncommon to eastern Lake Erie. In general, the surveys indicated a benthic community typical for the existing depths and sediment types present. (Great Lakes Laboratory: 1979).

At present, no current benthic surveys are available for the Niagara River.

Population - The population of the two-county area has declined in the last decade as has the population of New York State. The State change from 1970-1980 was -3.8 percent; the Buffalo SMSA's change was -7.9 percent during the same period. The city of Buffalo accounted for a large portion of this drop (-22.7 percent) with the other major city in the area, Niagara Falls, accounting for the second largest portion of the drop (-16.6). Only Niagara County, excluding the city of Niagara Falls, had a rate of decline similar to that of the State as a whole (-3.7). Erie County has been showing a continuous decline since 1971 and the Niagara County population has been fluctuating annually within this same period. The outlying counties in the area have shown an increase in population with Allegheny, Cattaraugus, Genesee, Orleans, and Wyoming growing, and Erie, Niagara, and Chautauqua losing population. (U.S. Department of Commerce, Bureau of Census.)

Erie County had 263,944 families and 365,217 households according to 1980 Census data. The County's population is broken down into 532,234 females with a median age of 33.4, and 483,238 males with a median age of 30.0. About 12 percent of Eries population is age 65 or over. Approximately 27 percent of the County's population is 17 years old or under.

Niagara County's 80,258 households include 60,621 families. There are 117,716 females and 109,638 males in the County. There are 27,127 people age 65 and over (about 12 percent), and 63,254 persons 17 years old or under which is approximately 28 percent of the County's population.

The SMSA (Standard Metropolitan Statistical Area) has a wide variety of ethnic and racial groups. For 1980, the census category "Race Distribution" shows 11 percent of the Buffalo SMSA, 29.5 percent of the city of Buffalo, 6.2 percent of Niagara County, and 12 percent of Erie County population falling under the category "Non-White." In both counties and the city of Buffalo, the Black population has been steadily increasing from 1950-1970. Blacks represent the largest minority group with 9.2 percent of the SMSA'S population and the largest proportion of the Black population in the city of Buffalo at 26.6 percent. Native Americans were the second largest group in Niagara County at .9 percent. (Neither Tonawanda nor the Tuscarrora Indian Reservation are within the project areas. There is no indication of any negative impact on Native Americans in this area.)

More than 60 percent of the population is composed of residents of foreign birth or parentage from the countries of Italy, Poland, Germany, and Canada. Poles made up the largest ethnic group in 1960 and 1970 for Erie-Niagara Counties and the city of Buffalo. Polish is the most frequently reported spoken language other than English. Italians make up the second largest grouping with people of Canadian and German descent the next largest groups.

Agriculture and Farm Displacement - 1974 statistics show 1,487 farms in Erie County and 1,228 in Niagara County, a decline of approximately 20 percent since 1969, with a combined total of 368,000 acres in farmland with a product value of 73.6 million dollars. The major crops are corn for grain, corn for silage in Erie and Niagara, wheat and fruit in Niagara and dairying

Table D2 - Population

Municipality	1960 Total: Population	1970 Total: Population	Percent Change From 1960-1970	1980 Total: Population	Percent Change	Area in: Square Miles	Population Density Persons Per Square Mile 1960	1970
Erie County		1,113,491		1,015,472	-8.8			
Niagara County		235,720		227,101	-3.7			
Buffalo (C)	532,759	462,768	-13.1	357,870	-22.7	39.4	13,522	11,745
Tonawanda (T)	105,032	107,282	+2.1	91,269	-14.9	19.8.	5,302	5,418
Niagara Falls (C)	102,394		-16.4		-16.4	13.5	7,585	6,342
Wheatfield (T)	8,008	9,722	+21.4	9,609	-1.2			
North Tonawanda (C)	34,757	36,012	+3.6	35,760	-0.7	10.5	3,310	3,430

SOURCE: Socio-Economic Environmental Data Information System, 1982.
BUFFALO METROPOLITAN AREA COMPENDIUM OF MARKET DATA, 1982.

in Erie, followed by vegetable crops. Farm proprietors in Erie County numbered 1,939 and in Niagara County 1,601 in 1979. Proprietors income from 1970-1979 is currently rising. Laborers' and proprietors' income shows a somewhat steady, increasing trend. The numbers of farm proprietors has also fluctuated and is now at the 1971 level. This is somewhat different from the long-term national trend toward fewer and fewer farms. Farm employment has generally risen to a high of 2,658 in 1979. (SOURCE: Data Resources Inc., Lexington, MA).

Aesthetics - Aesthetics refer to the perception of natural and man-made beauty and the judgment involved in deciding what is beautiful. The two-county area provides a wide variety of most aspects of aesthetics-urban and rural areas, new and old developments, noisy industrial areas and tranquil green spaces including a major scenic point of the U.S. - Niagara Falls.

Generally, much of the waterfront in the project area is dominated by industry. However, the waterfront has a very mixed pattern of land use.

The Inner Harbor in Buffalo is dominated by industrial uses. Plants and mills are interspersed with abandoned facilities and areas which have reverted to natural plant succession. The outer Harbor has large open spaces, Times Beach (containing both terrestrial and aquatic plants), storage areas for the Port of Buffalo, marinas, and waterfront residential and business developments.

The Black Rock Channel includes the outlet for Scajaquada Creek, which is laced overhead with roadways and is a collecting spot for debris, and the Black Rock Lock, another collection point for debris, which is between the U.S. Army Corps of Engineers and the City of Buffalo Water Treatment Facility.

The Niagara River at its source is separated from the community by Interstate 190 and has a very mixed land use on the east bank. On the west bank is Fort Erie, Ontario, and the Niagara Parkway where a green space has been preserved for public access along much of the shoreline. Downstream on the Tonawanda Channel, the west and east banks are dominated by residential development with a notable exception of the State parks on either end of Grand Island.

As aesthetic values depend on the perceiver, there are most likely many different ideas of what the waterfront area should look like. These differences in aesthetic values are often reflected in the larger question of appropriate land use for the waterfront, something all recognize as a valuable resource. There are a wide variety of proposals including residential, industrial, and recreation, which are described in the 1981 Corps of Engineers BUFFALO HARBOR REVITALIZATION STUDY.

Another issue related to aesthetics is that of public access. THE NIAGARA RIVER ENVIRONMENTAL PLAN: SUMMARY REPORT, Erie and Niagara Regional Planning Board, June 1972 states that:

> "Existing development along much of the shoreline is a significant barrier to the personal enjoyment of the scenic beauty of much of the Niagara River and its shoreline. Much of the shoreline was developed and is currenty maintained with

little consideration of scenic impact and provision for access to, and personal enjoyment of the River. Shoreline activities are often incompatible with personal enjoyment of the natural resource."

"In the city of Buffalo, the uses of the shore are oriented to the activities of the city's central business district. The New York State Thruway takes up much of the shoreline, acting as a wall between the river and the nearby large concentrations of urban population.

"Access to the river in the Tonawanda area is even less adequate than in Buffalo. The shoreline is almost wholly taken up by heavy industry. A solid barrier of railroad tracks is situated between the shoreline industrial complex and the inland residential concentrations."

Access to the waterfront has improved somewhat since this report was published through developments like the bridge to the fishing area near Riverside Park, the completed portion of the Riverwalk, and the Erie Basin Marina, but access is still widely acknowledged as an ongoing concern.

Drift and debris in the project area has collected along the shoreline over the years and created what could be considered an eyesore, urban-blight, and a sign of Buffalo's losses in its industrial base. The drift and debris sites vary from the skeleton of the Ganson Warehouse to the wooden docks, all askew and crumbling into the river, to driftwood accumulating along the shorelines.

Noise - Noise is sound without value. (ER 1105-2-105, Information Supplement No. 1) It is unwanted and intrusive. The impacts of noise are affected by population density, income, and socioeconomic level. A recent study - THE URBAN NOISE SURVEY by Sanford Fidell of Bolt, Berenek, and Newman for USEPA Office of Noise Abatement and Control, August 1977, found that neighborhood satisfaction is inversely related to noise exposure. Annoyance caused by noise was found related to reasonableness of the sound. Predictably, noise annoyance is more prevalent during the evening and night and higher among those bound to the noisy area. Urban noise caused annoyance was associated with vehicular traffic. Urban areas may have an ambient noise level of 70-80 decibels or more.

The project area varies widely in its land usage from all industrial use on the Buffalo River shores to primarily single family homes and vacation homes on the upper portions of the Niagara River. On the shorelines there are generally some buffer zones between residential and industrial uses, which ease noise impacts. However, some areas along the Buffalo River some residential areas are behind the industrial uses on the shoreline and may be subject to higher than average urban noise conditions.

Man-Made Resources - Man-made resources are structures, objects, or sites which have been created, manufactured, or constructed by people. There are innumerable man-made resources in the project area. Business and

Industrial facilities, such as grain mills, factories, marinas, the Port of Buffalo, dominate the heavy debris areas. There are also railroad lines, piers, wharves, bridges, and docks scattered along the shoreline, as well as the Black Rock Lock and Tonawanda Harbor. Multiple unit housing, single family homes, and parks are interspersed throughout the area. Particulary in the Buffalo Harbor area, a number of these structures are underutilized, unused, and dilapidated. Drift and debris sometimes clog Buffalo Sewer Authority outfall and cause back pressure which reduces system efficiency. The Sewer Authority carries out an annual clearing program to remove the debris. The Black Rock Lock is also troubled by drift and debris collection which must be cleared or it would interfere with lock operation.

Business and Industry - The economy of the two-county area is built on steel, grain, automotive, transportation, and power with a diversity of manufacturing operations. Niagara Falls is a leading center of the nations metallurgical industry and an important producer of chemicals and abrasives. In addition to the above industries, Buffalo is also an important area for research with approximately 11,000 persons employed by about 150 research laboratories in the area.

In manufacturing, the leading industry groups in 1974 were primary metals, transportation equipment, air craft production, nonelectrical machinery, and food processing.

Railroads and the Port of Buffalo play an important role in transportation.

Of service industries, business services ranked first in Erie County and tourist services in Niagara County. The Buffalo SMSA in 1977 contained 9,845 establishments in retail trade with retail sales of 4.5 billion. There were 2,066 wholesale trade establishments with sales of 8.1 billion.

Mining activities in the Buffalo SMSA are nominal. In order of value, commodities in Erie County were stone, lime, sand and gravel, natural gas, and clays. In Niagara County, stone was the primary commodity in 1977.

Table D3 - 1977 City County Data Book, Business and Industry Profile, Aggregation of Erie and Niagara Counties

	1954	1958	1963	1967	1972
Manufacturing					
Establishments	1,829	1,820	1,808	1,719	1,632
Payroll ($000)	933,873	954,466	1,104,307	1,354,800	1,617,900
Value Add ($000)	1,677,778	1,715,627	2,068,561	2,653,400	3,146,300
New Cap Exp $000	139,477	109,102	116,347	223,600	248,000
Employees	200,801	173,874	162,942	176,100	151,700
Production Workers	152,882	122,778	117,921	129,000	108,700
Retail Trade					
Establishments	12,370	13,328	11,633	11,330	10,900
Sales ($000)	1,338,590	1,521,274	1,675,205	2,048,828	2,780,548
Payroll ($000)	159,494	177,311	197,469	249,636	351,271
Employees	63,847	65,000	62,750	67,739	78,095
Selected Services					
Establishments	5,024	6,518	6,774	7,340	8,742
Receipts ($000)	171,102	209,148	257,573	323,050	587,432
Payroll ($000)	50,809	60,271	80,332	100,389	191,661
Employees	18,030	19,428	21,383	22,684	32,077
Wholesale Trade					
Establishments	1,798	1,969	2,056	2,015	2,190
Sales ($000)	1,965,176	2,386,226	2,897,186	3,053,594 (1)	4,297,500
Payroll ($000)	100,996	112,924	131,207	152,903 (1)	234,554
Employees	21,848	22,537	21,605	22,282 (1)	25,284
Mineral Industries					
Establishments		29	24	30	19
Payroll ($000)		2,362	3,899	3,700 (1)	2,600 (1)
Ship Value ($000)	6,873	7,510	7,481	9,700 (1)	7,300 (1)
Value Add ($000)			4,975		5,800 (1)
Cap Exp ($000)				1,071	
Employees		367	532	500 (1)	200 (1)

(1) Aggregation includes only nonsuppressed data.

SOURCE: Socio-Economic Environmental Data Information System (SEEDIS), Lawrence Berkeley LBL.

Property Values and Tax Revenues - Tax revenues for the Buffalo SMSA in 1977-1978 amounted to $731.5 million (in 1979 dollars). Of this total, $517.1 million were property taxes and $173.2 million were general sales and gross receipts taxes. Other taxes amounted to $41.2 million. The Buffalo Area Chamber of Commerce Research and Marketing Department reports:

Table D4 - Tax Rates per $1,000 of Assessed Valuation

	Equalization Rate	Combined (1)	County	Town/Village/ City Tax	School Taxes
		1977-1978			
Erie County					
Buffalo	47	105.41	22.58	82.93	39.49
Tonawanda (T)	23	143.16 165.67	46.22	24.89	72.05- 94.58
Niagara County					
Niagara Falls	56	88.08	14.63	35.68	37.77
North Tonawanda	29	151.54	29.37	49.12	73.05
Wheatfield	36	65.07- 85.84	23.14	None	41.93- 62.70
		1981			
Erie County					
Buffalo	32.23	117.592	31.296	86.296	(2)
Tonawanda (T)	15.41	198.433- 222.461	64.537	35.453	98.443- 122.471
Niagara County					
Niagara Falls (C)	38.67	103.300	18.949	40.879	43.472
North Tonawanda	N/A	N/A	N/A	N/A	N/A
Wheatfield	23.31	91.801- 109.887	31.544	-	60.257- 78.343

(1) High-Low rates range reflects variation in school rates as a result of more than one school taxing area in community.

(2) City of Buffalo school tax is included in the total city tax rate.

Total assessed valuation in 1979 dollars, for the year 1976 was $4.3 billion for the Buffalo SMSA. The Erie County total including State-assessed property was, $3,277,173, and the Niagara County figure was $1,036,662.

Labor Force, Employment, Earnings and Income - According to a survey in ECONOMIC DEVELOPMENT IN THE ERIE-NIAGARA REGION done by the Steering Committee of the E&NCRPB in June 1975:

"Erie and Niagara Counties industrial firms surveyed report a labor complement consisting of about one-third each of skilled and unskilled workers and an additional 11 percent in supervisory and craftsmen category. Other personnel are 8 percent each for professional and clerical, 6 percent for managers, and 3 percent each for sales and service workers."

"Buffalo industry has a higher proportion of unskilled workers and a lower share in the supervisory and professional and technical categories than industry in outlying areas. Geographic differences in Niagara County are smaller.

"Sales and service workers comprise almost 50 percent of the work force in commercial firms. Managers, skilled workers, unskilled workers, and clerical help represent between 9 and 11 percent each.

"Commercial labor complement varies somewhat between the two counties. There is a higher proportion of managerial and sales personnel in Erie County; in Niagara County, service workers are a larger share of total commercial employment.

"Clerical workers are the largest single occupational group (40 percent) reported by respondents in the government and professional category. Professional and technical workers represent 28 percent of employment and managers, and administraders 12 percent. The city of Buffalo has a substantially higher proportion of clerical workers employed in government institutions and professional firms than the rest of the region. Outside the central city, the proportion of professional and technical workers is considerably higher; 53 percent compared to 16 percent in Buffalo.

"Skilled and unskilled workers are about half of the total employment (56,598) reported by the firms and institutions which provided labor force information in the survey."

Manufacturing remains the mainstay of employment in the SMSA. In 1978, nearly 145,000 persons were employed in manufacturing, followed by trade with 115,000 persons employed and services with 103,000, persons employed. In May 1980, these figures had dropped to 133,000 for manufacturing, 113,000 for trade, and 100,000 for services. Almost all of the manufacturing industries showed a decrease in employment which may be a part of a larger national trend toward higher unemployment rates. However, electrical machinery did register a large increase of 5.1 percent.

The decrease in the unemployment rate in the SMSA from 10.8 percent in 1976 to 7.3 percent in 1979 can be attributed to the increase in the number employed in Erie and Niagara counties (43,000 between 1975 and 1979) and a less

Table D5 - Recent Trends in the Labor Force, Unemployment, and the Unemployment Rate, Buffalo Labor Area

Item	1974	1975	1976	1977	1978	1979	1980(1)
Annual Averages: 1974-1980							
Buffalo SMSA							
Labor Force	534,600	553,400	558,600	562,500	567,300	581,400	578,300
Unemployment	36,500	59,500	60,300	52,600	45,000	42,700	57,100
Unemployment Rate	6.8	10.8	10.8	9.3	7.9	7.3	9.9
Erie County							
Labor Force	438,800	454,100	458,000	461,800	464,800	475,700	472,100
Unemployment	29,000	48,500	49,400	43,800	37,400	34,900	45,500
Unemployment Rate	6.6	10.7	10.8	9.5	8.0	7.3	9.6
Buffalo City							
Labor Force	182,200	190,900	192,600	193,400	193,400	198,000	197,800
Unemployment	15,400	25,800	26,200	23,200	19,800	18,500	24,200
Unemployment Rate	8.5	13.5	13.6	12.0	10.2	9.3	12.2
Niagara County							
Labor Force	95,700	99,300	100,600	100,700	102,500	105,700	106,200
Unemployment	7.500	11,000	10,900	8,800	7,600	7,900	11,600
Unemployment Rate	7.8	11.1	10.8	8.8	7.5	7.4	10.9
Niagara Falls City							
Labor Force	35,300	36,900	37,400	37,200	37,700	38,900	39,400
Unemployment	3,300	4,900	4,800	3,900	3,400	3,500	5,100
Unemployment Rate	9.4	13.2	12.9	10.5	9.0	9.0	13.0

(1) Preliminary

SOURCE: Department of Labor, New York State

X

substantial increase in the labor force (28,000) during the same period. However, estimates for February 1982 indicate the unemployment rate in the SMSA was 14.3 percent. A decline in manufacturing employment was primarily responsible for the decrease in employment. The average annual rate of unemployment for the preceeding 12 months is 10.0 percent.

Personal income includes not only wage and salary disbursements, commissions, tips, and propietors income, but also dividends, interests, rent, and transfer payments. In the SMSA, the precentage of total personal income, by place of work, increase was 6.7 percent from 10.1 billion in 1975 to 10.8 billion in 1978 according the the Bureau of Economic Analysis.

Earnings in the SMSA increased 7.1 percent between 1975 and 1978. Per capita income in the SMSA rose from $7,549 in 1975 to $8,304 in 1978 - an increase of 10.0 percent. (Bureau of Economic Analysis).

The effective total buying income for the area was $9,196,155,000 and the Median Household Effective Buying Income was $17,326 in 1979. (Bufffalo Area Chamber of Commerce)

Table D6 - 1977 City County Data Book, Families and Income Profile
Aggegation of Erie and Niagara Counties (2)

	Family Income		
	1950	1960	1970
Number of Familes	278,765	332,979	337,529
Percent Low Income (1)	16.4	12.3	7.1
Median Family Income	$3,494	$6,449	$10,415

	Public Assistance Recipients	
	1972	1976
AFDC	66,078	62,470
AFDC children		43,225
Average Monthly Payments/Families ($)	230	309
SSI		
Total		22,711
Aged		8,984
Payments Total/Monthly ($000)		3,000

(1) Low income defined as under $2000 for 1950 and as under $3000 for 1960 and 1970.

(2) Items defined as median values are weighted average of medians.

SOURCE: Socio-Economic Environmental Data Information System, LBL, Berkeley, California, 1982.

Housing - The total number of housing units has risen steadily since 1940 although there was a drop off in construction between 1960 and 1970. The percentage of owner-occupied units has risen steadily since 1940 and the mobility (percent moved into in last 5 years) in 1970 was slightly above 40 percent). Median rent in 1960 was $73 and $81 for Erie and Niagara County, respectively. In 1970, it was $99 for Erie County and $100 for Niagara County.

Table D7 - Housing - Aggregation of Erie and Niagara Counties
1977 City County Data Book

	1940	1950	1960	1970
Total Housing Units	264,062	317,423	409,765	433,469
Percent built since last census		13.8	22.8	13.4
Occupied units	250,886	306,059	386,572	18,255
Percent Owner occupied	40.2	53.9	60.1	62.1
Median/Mean Occupants	3.4md	3.2md	3.4mn	3.2mn
Median value Owner-occupied ($)			14,803	18,032
Median rent ($)			74	99
Mobility (Percent moved into in last 5 years)				42.4

CONSTRUCTION (1975-1976)

New private units authorized	6,601
Percent Single Units	74.5
Percent 5+ Units	20.1
Total permit value ($000)	170,181
Average Per Unit ($/Unit)	25,781

SOURCES: Socio-Economic Environmental Data Information System, LBL. Berkeley, CA, 1982. BUFFALO METROPOLITAN AREA COMPENDIUM OF MARKET DATA, Buffalo Area Chamber of Commerce, Buffalo, NY, 1982.

By 1980 Erie County had 389,038 housing units and Niagara County 85,037, according to ADVANCE REPORTS OF THE 1980 CENSUS OF POPULATION AND HOUSING FOR NEW YORK. This is an increase of 7.8 for Erie County and 13.8 for Niagara County, from 1970 figures. These increases however, show growth in the municpalities surrounding the metropolitian areas of Niagara Falls and Buffalo. The city of North Tonawanda shows an increase of 20.2 percent compared to 2.0 in Niagara Falls. Buffalo actually had a negative growth rate of 5.8 percent.

Recreation - The two-county area provides a very wide range of seasonal recreation where water plays a key role with Lake Erie to the west and Lake Ontario to the north and the Niagara River connecting both lakes (see Plate D2 in Appendix a. of the Environmental Assessment). Visitors to Niagara Falls play an important role in the regions economy. Facilities for most outdoor activities are within a reasonable drive from the area. There are a number of stadiums, gardens, halls, libraries, theatres, and parks. Spectator sports are a particularly important part of the social life of the two counties.

The project area includes recreational boating, fishing and sport fishing areas, public water-oriented parks, water-oriented scenic ares, tourist spots, and a naval museum. There are, however, very few areas designed for swimming in the project area and boaters say that there are not enough docking and storage spaces for recreational craft. Access to the shoreline for active and passive recreation is limited (For more detailed information, see the Buffalo District report on BUFFALO METROPOLITAN AREA, NY, WATER RESOURCES MANAGEMENT).

Health and Safety - As a large urbanized area, the Buffalo SMSA (Standard Metroplitan Statistical Area) has all of the basic services for ensuring the health and safety of its population. These include sewer and water treatment facilities, more than 25 hospitals, community health centers, ambulance services, research institutes for Cancer and chronic disease, numerous physicians, dentists, and other health care professionals, police and sheriff's departments, and professional and volunteer fire companies. The health effects of air and water pollution are an important concern to this industrial area. Currently, there are several studies being carried out on toxins in the local environment.

The project area itself is also serviced by the Buffalo Fire Departments fire boat and the U.S. Coast Guard Station in Buffalo Harbor. Within the study area, the floating debris presents a navigational hazard for recreational craft and therefore, a potential safety hazard for boaters. Recently, marine operators reported approximately $151,000 in annual damages to recreational craft. A corresponding amount of risk to personal safety could be expected.

Land Use - The two-county SMSA includes almost all forms of the land use.

"On a regional basis, the largest use of land is for agricultural purposes which comprises 45.9 percent of land resources. This is followed by forested/brushland (32.1 percent), Residential (10.4 percent), Wetland (2.2 percent), Industry (2.0 percent) and Outdoor Recreation (1.8 percent). The remaining (5.6 percent) land use is composed of public/semi-public, transportation, vacant, commercial, and water.

"Within Erie and Niagara Counties, these percentages are not broken down similar to the regional distribution. That is, of the 45.9 percent regional agricultural land use, 24.0 percent and 21.9 percent are found in Erie and Niagara Counties, respectively.

However, this represents 36.2 percent and 65.3 percent within Erie and Niagara Counties land uses; or, one-third of Erie County land area is devoted to agricultural practices and two-thirds of Niagara County is in agricultural use.

"The largest percentage of land use in Erie County is forested/brushland (39.5 percent) followed by agricultural (36.2 percent), residential (12.6 percent), industry (2.2 percent), outdoor recreation (2.0 percent), and wetland (1.9 percent). The remaining (5.6 percent) land use is used for transportation, public/semi-public, commercial, vacant, and water.

"Niagara County's largest use of land is agricultural (65.3 percent). This is followed by forested/brushland (17.4 percent), residential (6.4 percent), weltand (12.8 percent), industry (1.8 percent), and outdoor recreation (1.5 percent). Public, semi-public, vacant, transportation, water, and commercial comprise the remaining (4.8 percent) area."

Erie and Niagara Counties Regional Planning Board. Report 6, LAND USE - PRESENT AND FUTURE, October, 1978 (see Plate D3 of Appendix a of the Environmental Assessment.

For the specific project area, Buffalo Harbor is characterized mostly by a mix of vacant and industrial land, with some recreational use (Erie Basin Marina and LaSalle Park for example) and a small amount of residential development in the Erie Basin Marina area. Along the Niagara River to the downstream (northern) project limit, which is the Federal limit of navigation, land use is again industrial, business, recreational, and residential on either side of the river. The actual waterfront is cut off from the rest of the city by a series of highways running parallel to the river.

Transportation - The Buffalo area has a complex highway system of belt lines and arterial routes which criss-cross Erie, Niagara, and adjoining counties and provide efficient service for a wide area. The New York State Thruway provides access to the Peace Bridge, which crosses the Niagara River between Buffalo in the United States and Fort Erie in Canada. More than 400 square miles in and around Buffalo are served by the Niagara Frontier Transit System, which is also called "Metro Bus." The service is a subsidiary of the Niagara Frontier Transportation Authority, which controls and directs transportation in Erie and Niagara counties.

The primary air transportation service is provided by the Greater Buffalo International Airport, which is also managed by the Niagara Frontier Transportation Authority. Four major carriers provide daily jet service in the Buffalo area. Additional air service in the SMSA is provided by the Niagara Falls International Airport. This airport is part of the Niagara Frontier Port of Entry, and it is designated as an international landing airport.

The principal supplier of rail service in the Buffalo area is the Consolidated Rail Corporation (Conrail), which includes the former Penn Central, Erie-Lackawanna, and Lehigh Valley Railroads. After Conrail began operation, the

Buffalo area was also included in the service area of the Delaware and Hudson Railroad. In addition to Conrail and the D&H Railroad, the area is served by the Canadian National, the Chessie System, and the Norfolk & Western. In 1975, rail passenger service was restored to the area when Amtrak opened service between Chicago and Boston or New York City via Buffalo. Amtrak provides service to more than 600 passengers each day on the Lake Shore Limited. Within the project area, transportation directly to the waterfront is limited and access is by car, bicycle, or walking from regular bus lines.

Institutional - A number of institutions deal directly or indirectly with resource management, and their management plans and programs comprise part of the general framework within which decisions regarding future harbor development will be made. The cities and towns within the project area have a primary role in the management of their waterfront properties. They can attract acceptable uses of the land or discourage unacceptable redevelopment. Owners and occupants of waterfront property also have an inherent interest in the project area. Other area organizations which have an ongoing interest in the waterfront area include: Buffalo and Niagara Falls' Chambers of Commerce, Niagara Frontier Transportation Authority, Conrail and ports users groups, Erie County Industrial Development Agency, the Waterfront Planning Board, Urban Waterfront Advisory Committee, Buffalo Ornithological Society, Erie and Niagara Counties Regional Planning Board, city of Buffalo's Department of Environment and Planning, the Sierra Club, and area wide tourism related businesses and agencies.

Many State agencies are also concerned with coastal related activites such as the Council of Upstate Ports of New York, Office of Parks and Recreation, Department of Transportation, and the Department of Environmental Conservation.

On a Federal level, the Department of Transportation, Department of Commerce, the Army Corps of Engineers, and the Environmental Protection Agency are generally interested in water resources development.

Community Cohesion - Community cohesion is the unifying force of a group of people in a common area resulting from one or more characteristics which provide a commonality such as race, eduction, income, ethnicity, religion, language, social class, or mutual economic and social benefit. Community cohesion also refers to the inferred relationships among persons who have resided in a given area for a sufficient period of time to have established patterns of behavior with each other.

The general area has been subject to outmigration over the past 10 years. Recently, there has been an increase in unemployment and some loss of retail and manufacturing establishments. However, public sentiment in defense of the area is strong (perhaps related to the areas reputation for bad weather) and is exemplified by Buffalo's "Talking Proud" campaign.

Within the project area, community takes on different definitions depending on identification along the lines listed above. Individual perception of cohesion in any one community may vary widely within that same community.

Cultural Resources - Initial coordination regarding cultural resources for this project was instituted with the National Park Service and the New York State Historic Preservation Office as of May 1982. A preliminary Cultural Resources Assessment for the study area was recently completed by Buffalo District personnel. Copies of the assessment were forwarded to the New York State Historic Preservation Office, the State Archaeologist, and the Mid-Atlantic Regional Office of the National Park Service for review and comment. It is the opinion of the State Historic Preservation Officer, as stated in a response letter dated 24 June 1982, that this project will have no effect upon cultural resources included in or eligible for inclusion in the National Register of Historic Places. Therefore, no additional cultural resources investigations are planned.

D4. ALTERNATIVE PLANS

Alternative I: No Action. This alternative implies that no further action would be taken to collect drift and debris from the proposed project locale, other than the routine emergency measure presently in effect to collect floating debris. This alternative is the base against which other alternative strategies are compared.

At present, drift removal is primarily accomplished by the Corps of Engineers with its 30-ton derrick as an emergency measure to eliminate hazards to navigation and prevent drift from impairing operation of the Black Rock Lock.

Alternative II: Continous Removal of Drift. Establishing an annual program for the continous removal of drift in the project area. This could be accomplished by letting a yearly contract to have this work done.

Alternative III: One Time Cleanup of Sources of Drift and Debris. Implement a one-time cleanup program to rid the study area of the major sources of drift. This plan consists of removing all sources of drift, including dilapidated and partially dilapidated structures, loose on shore debris, floating debris, and derelict (wrecked) vessels. This alternative is the most feasible plan. Based on the National Economic Development benefit-to-cost ratio, Alternative III is the only plan which is economically feasible; i.e., Alternative III has the only positive net benefits which result in a benefit-to-cost ratio of greater than one. Implementation of this plan would not cause any significant negative environmental impacts.

Alternative IV: One Time Cleanup and Continous Removal of Drift and Debris. Combine Alternatives II and III; i.e., implement a one-time clean up program to rid the harbor of the major sources of drift and then have a formal annual maintenance program. The methods of disposal for this alternative would be the same as Alternative II.

The feasible means of disposal for these alternatives fall into one of three categories: destruction by burning, resource recovery, or disposal by landfill. The specific methodology for each of these categories is as follows:

(a) Burning in an Mobile Total Combusion Unit. This method is advertised as pollution-free;

(b) Hooker Chemical Energy Recovery. Reuse through burning of the debris in a furnace to produce energy for power plants, heating, or industrial processes. The Hooker Chemical Resource Recovery Facility in Niagara Falls, NY, is the closest such facility. This method was selected as the means of disposal because it is the least expensive method and it has no significant adverse impacts on the environment. This method creates energy by recycling the material and was the first choice of the New York State Department of Environmental Conservation;

(c) Landfill Site. Landfill would require using an existing sanitary landfill.

D5. ENVIRONMENTAL EFFECTS OF THE PROPOSED PLANS

Estimating future conditions for the project area without a Federal project is a step required by Federal Regulations. Regulations also require the consideration of the possibility of no Federal Action as one of the feasible alternatives courses of action. Since the evaluation of the impacts of implementing Alternative I: No Action yields essentially the same information as projecting probable future conditions for the project area, the two tasks have been collapsed into one and appear below. Alternative IV: One Time Cleanup and Continuous Removal of Drift and Debris is a combination of Alternative II: Continuous Removal of Drift and Alternative III: One Time Cleanup of Sources of Drift and Debris and therefore covers most of the impacts of II and III. For this reason, Alternative IV will be evaluated after Alternative I. Plans II and III will be evaluated for how they differ in impacts from the combined Alternative IV and consequently will follow the section on Alternative IV.

a. Removal.

(1) Alternative I: No Action - The following is what would be expected (i.e., the conditions) if no Federal action is taken other than the current emergency debris removal program.

Air Quality. Current environmental laws and standards, both Federal and State, are stressing reduced emissions and improved air quality standards. This combined with the recent closing of some industries in the Buffalo area may lead to some less adverse impact on air quality in the near future.

Water Quality. Current international water quality agreements and current Federal laws are stressing reduced discharges and improved water quality. Canadians are currently involved with studies which are trying to indentify sources of pollution within the Niagara River. These factors, tied with Buffalo's loss of some industry and water quality improvements by some remaining industries, would tend to favor improvement in water quality in the future.

Wetlands. National wetlands have been on the decline even with the passage of strict Federal and State laws. Future conditions will depend on the enforcement of these laws and passage of additional legislation, tied with public awareness, to further protect this important habitat resource.

Vegetation. Undisturbed vegetation is sparse within the project area and most areas within the project area are industrialized or at best urbanized. There are a number of strip parks along the Niagara River which, according to some local planning agencies, are scheduled for probable future expansion, which may increase the number of introduced ornamental plant species. The future of existing vegetation patterns will depend on future developmental trends on the Niagara Frontier.

Fishery. Aquatic life is influenced by the quality of water present. Since future water quality is expected to improve, the improvement in water quality could improve the type and numbers of benthic organisms that could be valuable food for present and future fish populations. Therefore, improving water quality could contribute toward an increase in the fishery and/or benefit fish habitat in the project area. However, the fishery of an area is based on other parameters in addition to water quality. Such parameters include a need for adequate spawning and nursery areas as well. Since these parameters appear to be limited in this highly industrialized area and are not expected to change significantly in the near future, the future fishery of the project area is expected to be approximately similiar in composition to current species and numbers.

Wildlife. The wildlife of an area is influenced by diversity of habitat types and degree of human disturbance in a given area. Since, undisturbed vegetative areas and wetlands are sparse within the project locale, no signifcant changes are expected unless economic expansion claims the remaining few utilized vegetated areas located in this already highly industrialized and urbanized area.

Endangered Species. It is assumed that any endanged species that currently utilize the area is a transient (FWS letter dated 11 August 1980). Conditions within the project area would not be expected to change such that there would be any significant effect on species protected by the Endangered Species Act of 1973.

Prime and Unique Farmlands. The project area is very urbanized and industrialized. The fate of the minor quantities of prime and unique farmlands located in the project area would depend on developmental trends and present and future legislation enacted for the protection of such lands.

Benthos. Benthic popluation are also influenced by the quality of water. Water quality is improving within the project area and as indicated in the existing conditions section (Benthos), species diversity increased during the 1970's in the harbor and Buffalo River area. If water quality continues to increase, there could be a corresponding improvement in the future quality of benthic organisms present in the study area.

Land Use. The Buffalo Harbor Revitalization Study by Gulf South Research Institute for the U. S. Army Corps of Engineers, Buffalo District (1981) found more than 60 plans for development in the Buffalo Harbor area alone. The Erie-Niagara Countries Regional Planning Board has done several studies on areawide development (e.g., THE 208 AREAWIDE WASTE TREATMENT MANAGEMENT STUDY REPORT NO. 6 LAND USE-PRESENT AND FUTURE, 1978, and ECONOMIC

DEVELOPMENT IN THE ERIE-NIAGARA REGION, 1975). Some proposals for future land use in the project area are compatable and some conflicting. One conflict is over access to the shore for the public. Currently, most of the land is privately owned and access is limited along most of the waterfront. Another community concern centers around whether future land use should be oriented toward industrial, business, residential, or recreational use, and how that use would be tied into the surrounding areas. Given the conflicts over best use, it is likely that waterfront property will probably continue to support a mixed land use.

The current trend in the project area has been toward industrial abondonment, particularly of grain silos. With no Federal action, these abandoned areas and vacant lands may continue much as they are and be subject to isolated action parcel by parcel. However, if current plans toward region-wide coordination of shoreline development like that going on in Buffalo Harbor and around the Seaway Trail in Niagara County continues; future land use may occur in a planned fashion with public input.

Without a Federal project, any demolition, collection, and disposal of debris would have to be undertaken by a public agency or private owner, other than floatable debris collected through the current emergency removal program.

In the future, the various institutions involved with shorelines along Lake Erie and the Niagara River may act separately (or not act at all) on shaping that shoreline and waterway use. They may continue to seek coordination among all the private, public agencies, industries and business, and individuals involved.

If the towns and cities in the project area should decide to remove the drift and debris, they will be hampered by the lack of Federal action because the burden of planning coordinating, financing, and carrying out the removal will be entirely up to the municipality.

Population - There may be a reversal or stabilization of the trend toward outmigration from urban areas. Higher interest rates discourage home buyers and revitalization efforts may encourage the already existing refurbishing of old urban neighborhoods (e.g., Allentown in Buffalo). No Federal Action is not expected to have any impact on population.

Agriculture and Farm Displacement - Plans for rural and suburban expansion and development frequently impact on farmlands. Some proposals for future SMSA land use could affect farms in the region. However, the absence or presence of a drift and debris project is unlikely to affect agriculture, so no further study of probable future conditions for agriculture and farm displacement was done. No Federal Action will not displace any farms.

Aesthetics - With no Federal project, aesthetic conditions in the project area could continue to vary by individual property owner and municipality, and debris will remain unless disposed of by local groups. If efforts at a more coordinated approach to waterfront planning are successful, a more carefully integrated pattern of land use may develop which could incorporate resolutions to current issues - like access to the shoreline, water-pollution, and an increase in green space and recreational areas.

Noise - If the current trend toward loss of population in the urban centers of the SMSA continues, general noise levels could decrease. Suburban noise levels could increase but either of these conditions would depend on a variety of factors like population density, community land use, etc. Within the project area, noise levels could decrease if the current trend, toward industry leaving the waterfront, continues. If revitalization efforts are successful, new development on the waterfront could increase sound levels again. The annoyance caused by these sounds will depend on their character, and residents/workers sense of their propriety. Affects of noise may be reduced by compatible land use and the establishment of buffer zones. No Federal Action will not significantly affect noise levels.

Man-Made Resources - Without a Federal project to remove drift and debris, such material will continue to contribute to the debris, and the Black Rock Lock and Buffalo Sewer Authority overflows will continue to be plagued by debris accumulation. Debris could continue to constitute a nuisance to shoreline businesses and residences. With revitilization, some independent cleanup efforts could occur or local authorities may undertake a removal program.

Business and Industry - The future of business and industry in the area is dependent on many variables including national policies, (e. g., budget cuts threatening closure of the Black Rock Lock would affect up to 13 firms in the area). Area retail business and manufacturing has been declining in recent years. If the economy fails to revive, this local trend could continue. However, concerted national efforts are underway to support existing and encourage new business and industrial development (e.g., two new hotels built or under construction in the city of Buffalo). If the No Action Plan is selected, there would not be a significant effect on area business and industry.

Tax Revenues and Property Values - If current trends continue both property values and taxes will continue to rise. Actual tax revenues of the municipalities could be affected by the amount of tax exempt, publicly owned, and under-utilized or abandoned waterfront property, which does not bring in revenue proportional to its value. This has been noted in the Buffalo Inner Harbor. If redevelopment plans are successful, tax revenues could increase with more economically advantageous land uses in waterfront areas. Those land uses that result in higher tax revenues may not necessarily meet community demands for greenspace, recreation, and shoreline access.

Without a Federal project, drift and debris will remain. This debris may depress, somewhat, shoreline property values. If local government carries out debris removal, all cost will have to be carried by local treasuries.

Labor Force, Employment, Earnings, Income - Continuation of the current trends would result in higher rates of unemployment, lower overall incomes, and buying power and an increase in dependence on public aid. These areas are deeply affected by national policy changes. Local revitalization efforts may stabilize or improve employment, drawing job opportunities into the area. New jobs may require some retraining of the existing labor force. No Federal Action on drift and debris removal will have no significant effect on the areas labor force, employment, earnings, or income.

Housing - If current housing trends (1970-1980) continue, the metro areas of the cities of Niagara Falls and Buffalo will show slow or negative growth, and the surrounding cities and towns a larger growth; perhaps influenced by the historic flight to the suburbs. However, revitalization efforts in both major cities may encourage growth in Buffalo and Niagara Falls. New construction may be limited by the relative lack of space and high interest rates, but several projects are already underway in the Buffalo Harbor area.

No Federal Action on debris removal could act as a very slight deterrent to housing development on the waterfront, but will not have any significant effect on the housing market in the project area or region. Private use as opposed to public use of the waterfront is currently a subject of community debate.

Recreation - The Waterfront is viewed as a somewhat underutilized or inappropriately designed resource. Planning agencies in both counties have stressed development and enchancement of the waterfront, particularly in relation to tourism. In the city of Buffalo, the River Walk Committee, and other groups and agencies have been working to insure that changes in shoreline land uses will be compatible with recreational use. If SMSA-wide policies on the waterfront are developed, this process may be speeded up considerably. No Federal Action will not significantly affect recreation in the area. The drift and debris may act as slight deterrent to visitors to the waterfront and may somewhat discourage reuse efforts.

Health and Safety - Health and safety issues in the region that are related to the waterfront, center around the city's water supply distribution system (in need of repair) and questions of environmental quality. Solutions to current air and water pollution problems are being studied by industry, citizen groups, and public agencies; e.g., BRIC (Buffalo River Improvement Corporation), Sierra Club, and USEPA (United States Environmental Protection Agency). Resolution of these problems could make a significant contribution to the area's quality of living.

It is possible that drift and debris in the area is somewhat polluted through uptake. The absence of a Federal Project for Drift and Debris Removal would leave a very small part of the waterfront pollution (the drift and debris) intact or for municipalities to handle. More significant is the threat to recreational navigation posed by collision of small craft with floating debris. Estimated frequency and associated costs can be found in Appendix C, Economics. Without a Federal project, this will continue to occur unless local authorities undertake debris removal.

Transportation - The most significant future development in the area transportation network is the rapid rail transit project under construction, which will link downtown Buffalo and the State University of Buffalo's Amherst Campus. Once this is built and coordinated with the Metro Bus system, a regional transit network will be in operation. If area-wide redevelopment efforts are coordinated, transportation to and around the waterfront may be improved. No Federal Action will not have any significant effect on transportation.

Community Cohesion - Relative community cohesion in the region is very difficult to predict as it may be affected by fluctuations in employment, the housing market, etc. Project area community cohesion will not likely be significantly affected by lack of a Federal project. Future development plans adopted by the municipalities could enhance or detract from any one shoreline community's cohesiveness. One North American city expert expressed concern expressed over "the sorting out of different incomes" in the waterfront housing under construction in the city of Buffalo, and the lack of connection of the new housing with the rest of the city. Resolution of these kinds of concerns in future planning may contribute to community cohesion.

The Water Resources Councils "Principles and Standards" and Corps of Engineers ER-200-2-2, "Policy and Procedures for Implementing NEPA" require that the physical, biological, and socioeconomic parameters described in D3a must be examined to determine impacts that the various proposed alternatives for the Corps water resources projects may be expected to cause. The following parameters would not be significantly affected either positively or negatively: Endangered Species, Prime and Unique Farmland, Wetlands, Wild and Scenic Rivers; Population Density, Mobility and Displacement, Agriculture, and Farm Displacement.

(2) Alternative IV: One Time Cleanup and Continuous Removal of Drift and Debris.

Air Quality and Water Quality will be temporarily affected in a minor adverse way. Air quality would be reduced by increased emissions from heavy equipment during the drift and debris removal operation. Water quality would also be reduced from the probable minor spills of fuels and oils used by the construction vehicles, and by the resuspension of amounts of bottom sediments and increased turbidity during debris removal. Also, increased levels of creosote could result if preventive measures during removal are not taken. Both parameters should return to preproject conditions soon after the debris removal operation is completed.

Aquatic and terrestrial vegetation is somewhat limited within the zone of direct drift and debris removal; so generally, impacts although adverse, would be expected to be only minor. If debris removal is performed from water-based equipment, impacts to terrestrial and aquatic vegetation would be minimized due to the fact that barges could float in close to shore without significantly disturbing the area. This in contrast to heavy equipment that would have to travel overland to the bank side and possibly even out into the water from shore, thereby disturbing both terrestrial and aquatic vegetation as the machinery proceded. The removal of the shore-based debris would disturb and possibly destroy small quantites of riparian vegetation, but this impact should be temporary in that disturbed areas would likely become naturally revegetated soon after removal is completed, or during the next growing season with common herbacous plants, weeds, and grasses native to this area.

Field investigations on area fishery (SUNY Brockport 1981) showed many adults in reproductive condition in the Buffalo River, but the scarcity of ichthyoplankton indicated the river area is not suitable as a reproductive/ nursery area. Debris removal should not have any short or long-term impacts on the fishery, and adult fish would probably just move out of the direct impact area during construction activities. The harbor area, as wells as the Buffalo River area - due to their highly developed shorelines, lack of or limited aquatic vegetation and periodic strong wave action - generally provides poor fish habitat.

However, in the Buffalo Harbor area, as macrophyte plant communities developed during the summer, more fish moved into the harbor area. Therefore, if drift and debris removal operations were completed before June there should be no significant impact to the fishery of the harbor. It is also assumed that in the Niagara River, as in the other project zone areas, if removal was completed early in spring (before spawning) or late in the fall with care to reduce turbidity plumes, no major affect to the fishery would be anticipated.

Wildlife, e.g., (mammals, amphibians, and reptiles) within the project area is sparse. Removal of shoreline debris would disturb existing wildlife populations, causing many of them to temporarily avoid the area. Some waterfowl and shorebirds may utilize these areas for nestings, but if removal is carried out early enough in the spring before nesting occurs, or late enough in the summer or fall after the brooding period, adverse impacts on wildlife should be minor and temporary. The Niagara River is utilized very heavily by waterfowl. Removal operations should not be scheduled for April - July to prevent distrubance to existing waterfowl populations that could be nesting. Removal operations in the fall may temporarily disturb nesting waterfowl utilizing the rivers and harbor during their annual migration. Wildlife may be temporarily displaced during removal operations but should return soon after construction is completed.

Impacts to the benthic communities should be minimal. Sediments from the Buffalo River and Buffalo Harbor have been classified as highly polluted according to 1970 EPA classification standards. (Great Lakes Lab., 1981) During removal operations, some attached organisms and benthos will be displaced and/or destroyed. This impact is deemed to be very insignificant and populations should become reestablished soon after removal operations are complete. The Niagara River has higher water quality and should correspondingly have a higher quality benthic community. Removal of debris and pilings should have only minor temporary adverse effects to benthos in the construction area. Removal of pilings and some debris will reduce benthic habitat, but this is not anticipated to affect the overall invertebrate population significantly.

Over time, it is estimated that Alternative IV will remove 90 percent of the total drift and debris in the project area (estimated at 207,700 cubic feet). Man-made resources will probably be unaffected as the structures scheduled for removal are dilapidated beyond repair and reuse. If debris is blocking or interfering with desired access by water, removal would benefit the man-made resources involved. Continuous cleanup will help eliminate debris

caused by the inevitable decay of other structures; (picking up an estimated maximum of 35,000 cubic feet) therefore, keeping the waterfront relatively free of debris.

Another indicator that will not be significantly affected is noise. There could be some temporary and periodic increase in noise during the actual collection and removal of debris by trucks, pile cutters, cranes, vessels, and other construction equipment.

Area transportation would only be affected during the actual collection and removal of drift and debris, which would be periodic, but then only slightly. Trucks and vessels transporting debris could temporarily increase the volume of onshore and marine traffic and could occasionally obstruct traffic flow during loading and unloading.

Employment could be increased or held steady if the actual work of collection and removal of debris is contracted out. This increase, if it occurs at all, would be minor (approximately 6-48 people) and short-term, occuring only for the duration of the source removal and then seasonally for the continual cleanup aspect of the alternative.

Some community facilities, that is, the Buffalo Sewer system and the Black Rock Lock, would benefit from this alternative by the reduction of debris sources and periodic removal of debris blockage, which is currently undertaken by the sewer authority and the Corps of Engineers in its emergency debris removal program.

Community cohesiveness could be improved by area residents seeing the results of debris removal, which in turn could contribute toward enhancement of civic pride and by seeing local and Federal commitment to redevelopment efforts. It is also possible that the removal of drift and debris could contribute to desirable community growth by (a) helping to carry out revitalization plans; (b) encouraging development by presite preparations; (c) enhancing land values, and (d) improving the aesthetic quality of the project area.

The towns and cities involved would have to coordinate with each other and with the property owners to fufill the items of local cooperation (see the Main Report), which would include such items as rights of entry, required permits and easements, and the local share of costs. The municipalities, however, would benefit from the Federal share of costs and Corps of Engineers expertise.

The area's housing stock will also not be significantly affected. However, homeowners with waterfront property could benefit from the removal of and decrease in the amount of debris. It is also possible that the actual process of debris collection and removal could create a small nuisance in residential areas. The vast majority of sites are in manufacturing zoned areas.

Business and industrial property may be enhanced by anywhere from 5-75 percent of the costs of debris removal on their property or waterfront access to their property (see Apendix B, Real Estate). This varies according to the type and location of debris with a range from removal of floating debris in

the open river, which would result in the least increase in property values to removal of onshore structures which would yield the greatest. Marinas, which receive some damage and nuisance from floatable debris, would be a major beneficiary in the implementation of this alternative.

Area recreation would be considerably enhanced by removal of drift and debris and their sources, as it is recreational craft and marina facilities that run the greatest risk of damage from collisions with floating and submerged debris. It is estimated that this Alternative IV would eliminate 90 percent of the annual damages now occuring.

The cleanup would also reduce the cost of site preparation or redevelopment by the site owners, thereby making the property potentially more desirable for reuse. Reuse of idle or underutilized parcels is (for Buffalo Harbor) a goal of local planning.

The aesthetics of the area will be considerably improved by this alternative which will eliminate many sources of, as well as existing, debris. Although some observers may view drift and debris as "rustic", creating a marine or waterfront atmosphere, there is much support for a cleanup program among local agencies, and because this alternative cannot eliminate 100 percent of the debris that comes annually from tributaries, some areas will undoubtedly retain their scenic flavor. Actual removal operations may have a negligible effect on the appearance of the area where work is underway.

Removal of the estimated 90 percent of the debris in the project area will likely increase the safety of recreational boaters and marina facilities, who receive the most damages from drift.

Property values will be increased by a percent of the actual cost for individual site cleanup ranging from 0-75 percent which could result in a significant increase in property values in the areas with heavy drift/debris site concentrations. A rise in property values could result in an increase in tax revenues. In any event, the site cleanups could act as an incentive for more efficient utilization of the land; which in Buffalo Harbor, where the sites are most concentrated, is generating a tax revenue lower than the land's assessed value.

(3) Alternative II: Continuous Removal of Drift - The impacts of this alternative on biological parameters would not vary much from the "No Action" Alternative. Emergency removal is an established program. Alternative II provides drift and debris removal during the recreational boating season. Therefore, impacts would be more frequent - every boating season - but impacts would not vary significantly from the No Action condition and would be similar to present conditions. Estimates indicate that a maximum of 35,000 cubic feet could be picked up each year.

This alternative differs from Alternative IV in that there would be no removal of the sources of drift. This would be somewhat compensated for by the continuous removal of drift during the recreational boating season. Estimates indicate that 70 percent of the project area's drift could be removed by this alternative. Removal activites would probably be more intensive than with

Alternative IV, as sources will not be eliminated. No effects on Transportation, or those parameters mentioned on page D-33, as a result of this alternative.

Under the category of Man-Made Resources, the dilapidated structures that are a source of debris would remain in place. The continous removal should help in reducing debris at the Black Rock Lock and Buffalo Sewer Authority.

Noise caused by the continuous removal of drift, would probably occur with a somewhat greater frequency and continue somewhat longer than noise from the one-time cleanup, beacuse of the volume of debris to be removed. This will depend on how much floatable debris originates in the project area and how much comes from tributary sources. Since much of the collection would probably be done from the water, its expected that the noise from collection would blend in with other waterfront sounds.

Regarding Community Services, the only probable impact would be a slight decrease in the number of emergency calls the Coast Guard may have to respond to, that were caused by recreation craft collision, or motor fouling, with drift and debris.

Only about 5-10 people are estimated as required labor for collection of offshore debris, so, if contracted, the continous removal alternative would provide a small support to area employment, but would hardly have a significant effect on employment in the area.

Community facilites would receive some benefits as drift and debris in the Black Rock Lock and the Buffalo Sewer System Outfall would be significantly reduced.

Community growth and cohesion may be slightly changed by the improved aesthetics contributed by debris removal, but not to the same extent as under Alternative IV, because dilapidated structures, pilings, and mooring closures will remain in place.

Required institutional action would be coordination among the municipalities involved to fulfill the items of local cooperation.

The primary effect this project will have on housing would be some removal of nuisance drift adjacent to waterfront residences, and a general decline in the amount of drift in the area.

Property values may be enchanced for shoreline industries with implementation of Alternative II, but much less than the Real Estate estimates for Alternative IV, as onshore debris and nonfloating debris will not be removed. Marinas will receive just about the same benefits as with Alternative IV.

Conditions will be substantially improved for recreational boaters as the continuous cleanup will pick up about 70 percent or more of the floating debris which is the greatest hazard to boaters. Improvements in aesthetics maybe of benefit to recreational users of the waterfront.

Land use possibilities would be much less improved than with Alternative IV as is shown by Real Estate estimates for property enchancement (percentage of cost removal) for drift, which is 5 percent for most floating drift and 20 percent for a cove, slip or debris otherwise trapped in places where natural movement would be restricted. These values are fewer and smaller than those for nonfloating debris.

The area aesthetics would be improved somewhat by the removal of floating debris, but much of the "eyesore" consists of floatable debris on the banks and the dilapidated docks, pilings, and mooring clusters that dot the shoreline.

Recreational boating conditions will be considerably safer with this alternative, because floating drift is the worst of the drift and debris hazards for small craft.

(4) Alternative III: One-Time Cleanup of Sources of Drift and Debris - The impacts of this alternative on biological parameters would be very similiar to Alternative IV in that they both implement a one-time cleanup program to eliminate major sources of drift and debris. However, Alternative IV has a continued annual maintenance program. This annual program may, because of more frequent removal, cause greater impacts to fish and wildlife, but not to a significant degree. Alternative III will still utilize emergency removal at a reduced level from the existing program which would be expected to cause the same type of impacts as the annual maintenance program. Approximately 40 percent of the areas drift and most of the debris at the sites designated, would be removed. This is estimated at 3,050 cubic feet based on one survey.

Although a one-time cleanup is aimed at eliminating sources of debris, that which comes down tributaries or from the lake itself cannot be entirely eliminated, so the major negative impact of the alternative will come from the lack of provision for annual cleanup of new debris, except for the reduced emergency removal program. Also, some shoreline structures will always be decaying and will probably continue to add to the drift and debris in the area.

The only community service affected by this alternative is the Coast Guard. With a one-time cleanup, much of the debris and sources of debris would be removed, but some debris will undoubtedly come into the project area in the future. This means that the risk of collision with floating debris and calls to the Coast Guard for assistance, may begin to rise again as new debris accumulates.

The man-made resources, the Black Rock Lock and the Buffalo Sewer Authority Outfall and also Community Facilities, would be relatively free of debris after the cleanup, but in subsequent years, debris would probably begin to collect again in these areas.

Noise impacts would be limited to the one-time effects and would not reoccur annually, as with the other alternatives.

Any employment generated by the project would be of limited duration because of the one-time nature of the cleanup; however, no alternative would in any way significantly effect the area's employment picture.

Community cohesion and growth could be beneficially effected as area residents see the results of a cleanup program that fits in so well with local desires for waterfront improvement. As this larger cleanup efforts' affects would be somewhat more visible than Alternative II. Alternative III could be estimated to have a greater impact on community cohesion and growth.

Alternative III's effect on local institutions would only differ from other alternatives in that, if any maintenance was desired after the initial cleanup, that would be entirely the responsiblity of local authorities to plan, finance, and carry out any subsequent cleanup.

For shoreline residents affected, debris will gradually recollect over time. The same is likely to occur for business and industry, land use patterns, recreational, property, and tax revenues. All of the first time benefits of Alternative IV will occur, but over time, debris will reaccumulate with a tendency toward reestablishing the original conditions. Action by owners or local authorities will be necessary to do anything about the reoccurance.

b. Disposal.

(1) Method a. Destruction by Burning in an Mobile Total Combustion Unit - Destruction of burnable debris by a mobile floating plant combustion unit would virtually have no impact on the natural environment except for some increased air pollution and the filling of an existing landfill with nonburnable material.

Operation of this type of unit could result in some temporary localized noise. The burning which is advertised as pollution-free could allow smoke or odors (or both) to escape during the processing of debris. This could affect local aesthetics in the vicinity of the unit for the disposal period. Local authorities and Contractor(s) would obtain any required permits, (e. g., Department of Environmental Conservation's Air Resources Permit). These permits generally specify conditions which must be met to ensure least possible effect on the environment and local population. Any material that is not combustible in this unit would have to be otherwise disposed of. It is possible that the use of this disposal method would employ some people. This employment probably would not increase local employment but support it, and the Contractor's business as well, although in a very limited way. As is always the case with burning, there is some slight risk of an accident which could require community fire-fighting services. Depending on the location of the unit, some temporary inconvenience for local traffic could occur. This disposal method should require little or no trucking as it would be a floating plant.

All other parameters would not be significantly affected by this disposal method.

(2) Method b. Hooker Chemical Energy Recovery - This method would reuse the material through burning to produce energy. This would cause increases in air pollution. The nonburnable material would be put in an existing land fill.

Using Hooker Chemical Facility would increase utilization of a man-made resource for energy recovery and a support (although small) to existing local industry and employment. This facility is designed as an energy recovery plant and will be required to meet all local, State and Federal pollution standards and obtain any required permits. Truck transportation could cause some localized and temporary noise, dust, and otherwise affect area aesthetics. It was estimated that approximately 600 truck loads for Alternatives III and IV and 110 for Alternative II would be required to remove the debris within the designated sites in the project area. This additional traffic may disrupt local traffic patterns and could slightly increase risks to safety on routes traveled.

All other parameters will not be significantly affected by this disposal method.

(3) Method c. Landfill Site - Disposal of material at an existing landfill would cause increased disturbance at the fill site and may cause the site to be filled quicker than orignially scheduled. This could eventually affect fish and wildlife habitat adversely by causing other landfills to be constructed, thus, disturbing or destroying additional fish and wildlife habitat.

A landfill site could accept all of the types of material currently found as drift and debris in the project area. The volume of material to be disposed of could have a very slight effect on area land use. There is a great deal of pressure on existing landfill sites to dispose of the vast amounts of urban area waste. Additional drift and debris would further reduce existing landfill space and add to the pressure for seeking new acceptable landfill sites - a need already competing with other land use demands. The labor and equipment required for landfill disposal could be a support to local employment and business. Local authorities and Contractor(s) would have to obtain and follow required permits for this operation. The number of truck transits (the same as for Method b.) required to transport the drift and debris may temporarily disrupt local traffic patterns, increase safety risks, increase vehicular noise, and disrupt area aesthetics (causing dust, etc.).

The Contractor will be required to take every reasonable action to mitigate any adverse effects from the transport of the debris to the landfill site.

All other parameters will not be signifcantly affected by this disposal method.

D6. AGENCIES, INTERESTED GROUPS, AND PUBLIC CONSULTED

There has been an interest in drift and debris removal since before the 1965 Corps of Engineers report. New interest came with plans for revitalization of Buffalo area waterfront. A newsletter announcing the upcoming Drift

and Debris Removal Study was sent to all on the Buffalo Harbor Navigation Study mailing list (available for review at the District Office) which included over 300 Federal, State, and local elected officials, agency, business and industry representatives, media and interest groups, and individuals. A meeting to follow up on the Buffalo Harbor Revitalization Study's Public Workshop discussed debris removal at length.

Agencies represented at this meeting included:

Senator Moynihan's Office
Congressman Nowak's Office
U.S. Coast Guard, Buffalo Base
Erie and Niagara Counties Regional Planning Board (ENCRPB)
Erie County Industrial Development Agency (ECIDA)
Niagara Frontier Transportation Authority (NFTA)
City of Buffalo
City of Buffalo, Air Quality Technical Assistance
  Demonstration Project (AQTAD)
City of Buffalo, Harbormaster
Urban Waterfront Advisory Committe (UWAC)
Buffalo River Marina
Stieglitz, Stieglitz, and Tries

The final revitalization report (May 1981) briefly evaluated debris removal as an improvement measure. During the winter of 1981-1982, a survey of area public agencies, insurance companies, marinas, and marine operations was undertaken to gather information on drift and debris-related damages.

United States Fish and Wildlife Services were coordinated with regarding endangered species and the regional office has provided a Planning Aid Letter for this phase of the study (see Appendix Dc, Correspondence). New York State Department of Environmental Conservation has also supplied a letter of comment on the Drift and Debris Removal Study (See Appendix Dc).

The U.S. Fish and Wildlife Service in their 31 March 1982 planning aid letter (Reference Appendix Dc - Correspondence) identified both potential adverse and beneficial impacts to removal and disposal of drift and debris. They further indicated however, that overall, with sufficient mitigative measures, none of the alternatives would have severe adverse impacts. If the preferred plan is to be implemented; recommendations stated in the Fish and Wildlife Service planning aid letter will be incorporated where practicable in development of final detailed plans and specifications, to lessen any adverse impacts to the fish and wildlife resources of the Buffalo Harbor area.

Views of the public are being solicited through the review period for this document which will last 45 days after the date stamped on this report.

A notice of availability will be printed in the local papers and copies of this report will be sent to the Erie and Niagara County Libraries. Pertinent comments will be addressed in the next stage of study.

This Environmental Assessment will be in full compliance with environmental protection statutes and other environmental requirements <u>for this stage of the study</u> when this report is circulated to Federal, State, and local agencies.

A compete list of all agencies, organizations, and the interested public, that this study has been coordinated with thus far, can be obtained from the Buffalo District Office of the Corps of Engineers.

Table D7 - Relationship of Plans to Environmental Protection Statues and Other Environmental Requirements

Federal Statutes	No Action Alternative 1	Alternative 2	Alternative 3	Alternative 4	Disposal Method a.	Disposal Method b.	Disposal Method c.
Archeological and Historic Preservation Act as amended, 16 USC 469, et seq.	N/A	Full	Full	Full	Full	Full	Full
National Historic Preservation Act, as amended, 16 USC 470a, et seq.	N/A	Full	Full	Full	Full	Full	Full
Fish and Wildlife Coordination Act, as amended, USC 661, et seq.	N/A	Full	Full	Full	Full	Full	Full
Endangered Species Act, as amended, 16 USC 1531 et seq.	N/A	Full	Full	Full	Full	Full	Full
Clean Air Act, as amended, 42 UC 7401, et seq.	N/A	Full	Full	Full	Full	Full	Full
Clean Water Act, as amended (Federal Water Pollution Control Act), 33 USC 1251, et seq.	N/A	Full	Full	Full	Full	Full	Full
Federal Water Project Recreation Act, as amended, 16 USC 460-1(12), et seq.	N/A	Full	Full	Full	Full	Full	Full
Land and Water Conservation Fund Act, as amended, 16 USC 4601-4601-11, et seq.	N/A	Full	Full	Full	Full	Full	Full
National Environment Policy Act, as amended, 42 USC 4321, et seq.	N/A	Full	Full	Full	Full	Full	Full
Rivers and Harbors Act, 33 USC 401, et seq.	N/A	Full	Full	Full	Full	Full	Full
Wild and Scenic Rivers Act, as amended, 16 USC 1271, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coastal Zone Management Act, as amended, 16 USC 1451, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Estuary Protection Act, 16 USC 1221, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Marine Protection, Research and Sanctuaries Act 22 USC 1401, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Watershed Protection and Flood Prevention Act, 16 USC 1001, et seq.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<u>Executive Orders, Memoranda, Etc.</u>							
Flood Plain Management (EO 11988)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Protection of Wetlands (EO 11990)	N/A	Full	Full	Full	Full	Full	Full
Environmental Effects Abroad of Major Federal Actions (EO 12114)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, 30 Aug 76)	N/A	Full	Full	Full	Full	Full	Full
New York State Freshwater Wetlands Acts (Wetlands >12.4 acres)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Environmental Conservation Law - Article 15 (Protection of Water)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Local Land Use Plans (See Flood Plain Management EO 119 8, also)	N/A	Full	Full	Full	Full	Full	Full

The compliance categories used in th s table were assigned based on the following definitions:

a. Full Compliance - All requirements of the statute, EO, or other policy and related regulations have been met for this stage of the study.

b. Partial Compliance - Some requirements of the statute, EO, or other policy and related regulations, which are normally met by this stage of planning, remain to be met.

c. Noncompliance - None of the requirements of the statute, EO, or other policy and related regulations have been met for this stage of planning.

d. N/A - The statute, EO, or other policy and related regulations are not applicable for this study.

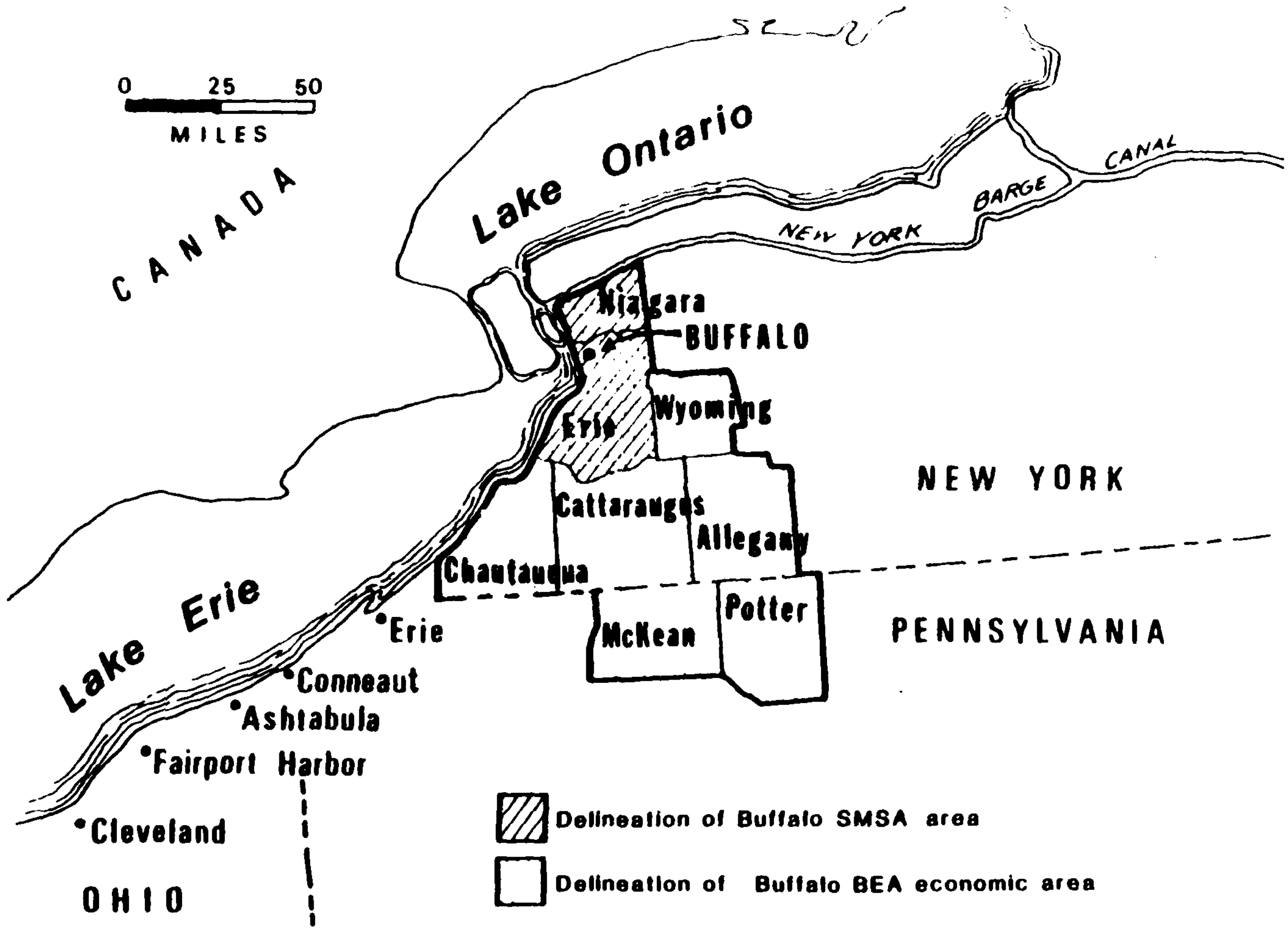
BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL

ENVIRONMENTAL ASSESSMENT

APPENDIX D

APPENDIX Da

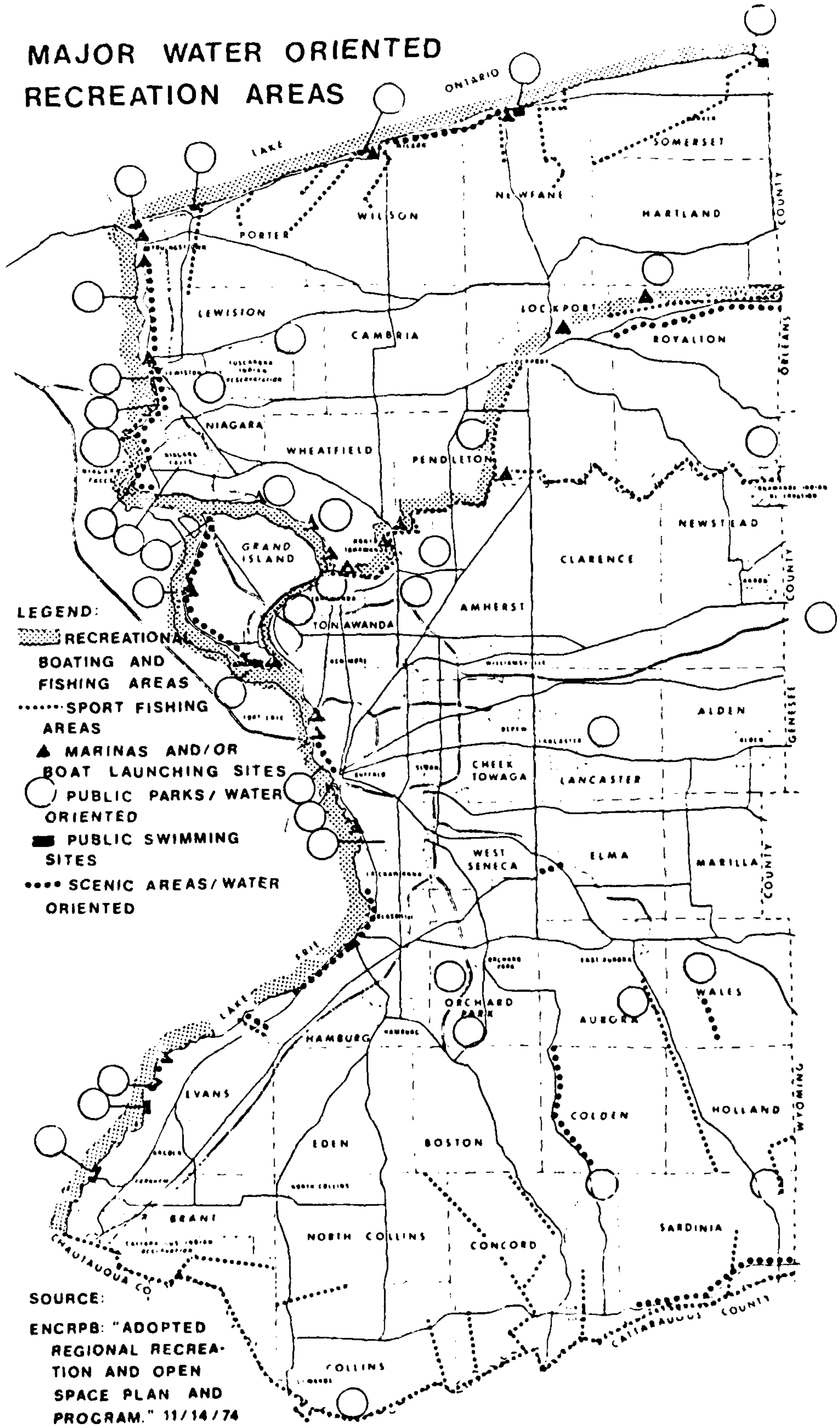
PLATES



Source: Gulf South Research Institute.

PLATE D1 - DELINEATION OF BUFFALO SMSA AND BUFFALO BEA ECONOMIC AREA

MAJOR WATER ORIENTED RECREATION AREAS



LEGEND:

- RECREATIONAL BOATING AND FISHING AREAS
- ······ SPORT FISHING AREAS
- ▲ MARINAS AND/OR BOAT LAUNCHING SITES
- ○ PUBLIC PARKS/ WATER ORIENTED
- ■ PUBLIC SWIMMING SITES
- •••• SCENIC AREAS/ WATER ORIENTED

SOURCE:

ENCRPB: "ADOPTED REGIONAL RECREATION AND OPEN SPACE PLAN AND PROGRAM." 11/14/74

GENERALIZED EXISTING LAND USE 1975

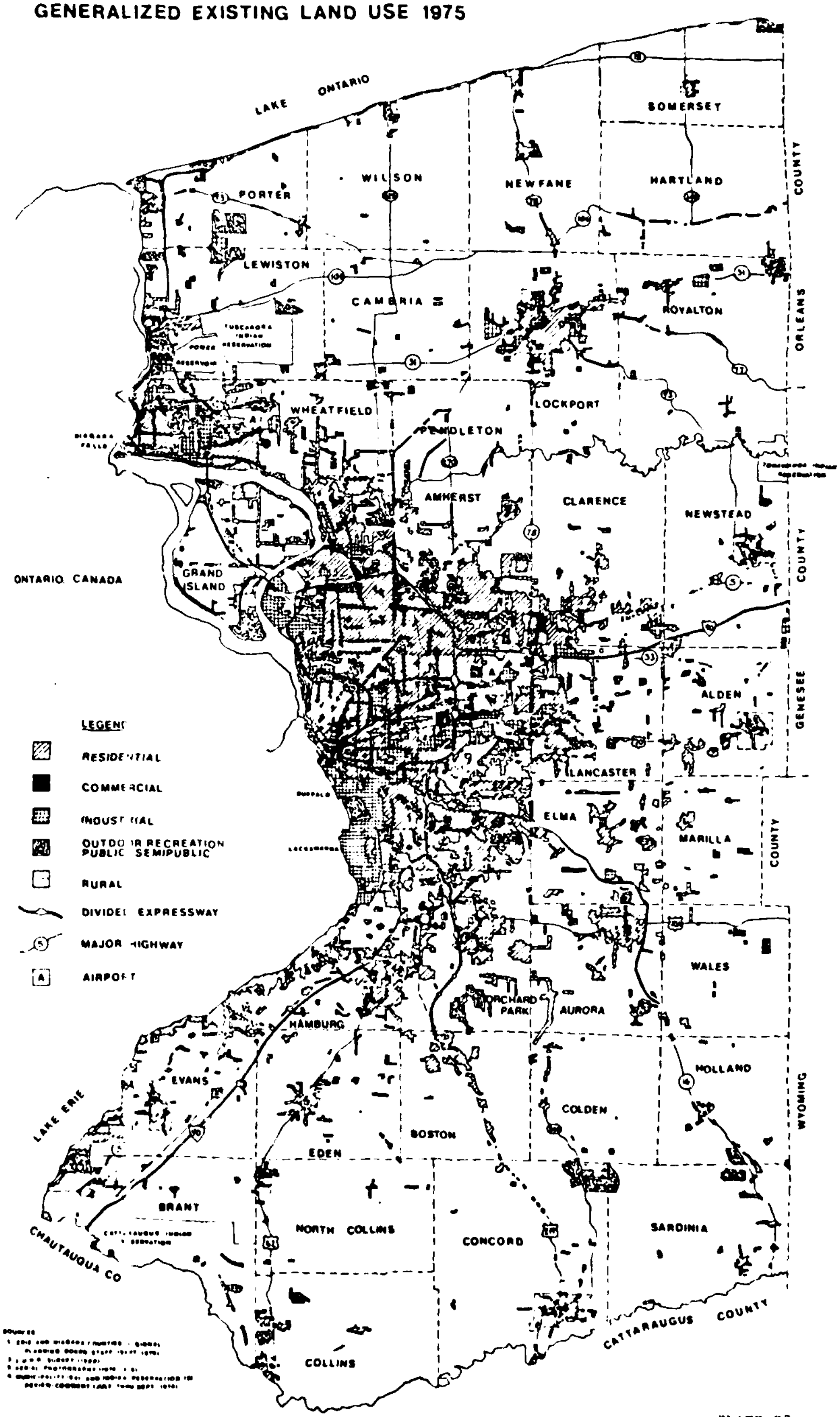


PLATE D3

BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL
ENVIRONMENTAL ASSESSMENT
APPENDIX Db

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U. S. Army Engineer District, Buffalo, Corps of Engineers. Review Report on Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor, New York, Niagara River, New York and Tributary Waterways. NY, February 1965.

For further references on the Buffalo SMSA see the Bibliography in the Reconnaissance Report to Buffalo Harbor that is listed above.

BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL

ENVIRONMENTAL ASSESSMENT

APPENDIX D

APPENDIX Dc

CORRESPONDENCE

United States Department of the Interior
NATIONAL PARK SERVICE
MID-ATLANTIC REGION
143 SOUTH THIRD STREET
PHILADELPHIA, PA. 19106

IN REPLY REFER TO

[illegible]

Mr. Charles E. Gilbert
Chief, Planning Division
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Gilbert:

In response to your request of 25 June 1982, my staff archeologist, Mr. Chapman, has reviewed the draft report entitled Cultural Resources Preliminary Assessment for the Buffalo Harbor Commercial Navigation and Debris Removal Studies.

The report is a very good preliminary assessment document. It is apparent that a great deal of effort was spent researching the cultural development of this important area. The research is well documented and the conclusions and recommendations are appropriate in most cases. Your staff is to be complemented for having produced a concise, readable assessment. Several items which warrant comment are addressed in the following paragraphs.

On page 1 in the Methodology Section, the list of primary sources does not contain references to either the State Historic Preservation Officer or the New York State Museum. Both of these have site files which in many cases do not duplicate each other or those available at the regional level. This is especially true of the results of small surveys which may have been performed for compliance. In the third paragraph on Page 10, there is mention of the Hopewell "phase"; in this case it should be plural as there are are a number of Hopewell phases in Ohio and other states. This also gets around the question of what exactly Hopewell should be called; a culture, a tradition, a horizon, etc.

The most serious comment involves the definition of low sensitivity areas on Page 20. An area cannot be designated as low sensitivity due to little or no data to judge its potential. The report should address more explicitly the types of locations which are not likely to contain sites. The past environment of the area must be used to make this determination. At present, it may be more appropriate to define areas of "unknown" sensitivity rather than low sensitivity. At the bottom of page 62 and continuing to page 63, there is a reference to the Historic Civil Engineering Landmarks. Should this be the Historic American Engineering Record?

Year of the Visitor

We hope that these comments will be useful to your staff in considering the cultural resources of this area. Thank you for the opportunity to review this report.

Sincerely,

Myra F. Harrison

Myra F. Harrison
Assistant Regional Director
Office of Cultural Programs

cc: New York SHPO

NEW YORK STATE PARKS & RECREATION Agency Building 1 Empire State Plaza Albany New York 12238 Information 518 474 XXXX
Orin Lehman, Commissioner

June 24, 1982

Mr. Charles E. Gilbert
Chief, Planning Division
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, N.Y. 14207

Dear Mr. Gilbert:

Buffalo Harbor
Drift Removal
Erie County

The State Historic Preservation Officer (SHPO) has reviewed the above project in accordance with the Advisory Council on Historic Preservation's regulations, "Protection of Historic and Cultural Properties," 36 CFR 800.

Based upon this review, it is the opinion of the SHPO that this project will have no effect upon cultural resources included in or eligible for inclusion in the National Register of Historic Places.

Should you have any questions, please contact the project review staff at 518-474-3176.

Sincerely,

Bruce Fullem

(for) Ann Webster Smith
Deputy Commissioner for
Historic Preservation

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

March 31, 1982

Colonel George P. Johnson
District Engineer, Buffalo District
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Attention: Charles Gilbert, Chief, Planning Division

Dear Colonel Johnson:

This constitutes our Planning Aid Letter on the alternatives for the Buffalo Harbor Drift and Debris Study, submitted in accordance with our February 9, 1982, Scope of Work. This in not to be considered our report under the authority of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Drift and debris provide habitat for a variety of fish and wildlife species. Removal of this drift and the cleanup of its sources would cause several adverse impacts to this habitat. The benefits to be accrued by fish and wildlife as a result of these operations would be minimal.

Existing Biological Conditions

The Buffalo River has been beset by pollution problems in the past. However, in recent years, as the water quality of the river has begun to improve, carp (Cyprinus carpio) and white suckers (Catostomus commersoni) have become abundant. Limited numbers of smallmouth bass (Micropterus dolomieui) and brown bullhead (Ictalurus nebulosus) have been found in the river. Benthic invertebrate populations are beginning to recover.

Eastern Lake Erie and the upper Niagara River support an excellent warmwater and coldwater fishery. Among the prominent game species found in the study area are coho salmon (Oncorhynchus kisutch), chinook salmon (Oncorhynchus tshawytscha), rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), lake trout (Salvelinus namaycush), walleye (Stizostedion vitreum), yellow perch (Perca flavescens), rainbow smelt (Osmerus mordax), and muskellunge (Esox masquinongy).

A variety of aquatic vegetation, including water celery, water stargrass, waterweed, and other pondweeds (Potamogeton spp.), is present in the study area. These plants provide excellent habitat for a variety of bird species. A man-made area called Times Beach supports populations of ducks, geese, shorebirds, and passerine birds.

The highly developed landscape of the study area limits populations of large mammals. Rodents are the predominant type of mammals found in the study area.

Adverse Impacts of Drift Removal

Floating debris provides habitat for a variety of invertebrates, which in turn provide a food source for many fish species, as well as for some aquatic animals. Loss of this food source would have detrimental effects on the fish populations. Some bird species utilize floating pilings as resting areas and as a perch for spotting fish. Removal of this debris would have minimal adverse impacts on waterfowl and shorebirds.

Adverse Impacts of Debris Cleanup

Old, dilapidated docks and other similar structures provide habitat for many fish species. They provide cover for juveniles and the smaller prey species, while providing foraging areas for larger, predatory species. They are also a major source of shade in this area. These structures provide a place for attachment for a variety of invertebrates, which comprise an important food source for the fish populations of the area. Birds utilize these docks as resting areas, and some species nest upon or under them. Amphibians and reptiles dwell in and around these structures.

Removal of these structures will cause several adverse impacts to the fish and wildlife of the area. Since these structures provide invertebrate habitat, their removal will reduce the food supply for the fish. In addition, substrate could be lost during removal of the pilings, resulting in further loss of invertebrate habitat. The turbidity produced while excavating these structures could adversely impact invertebrates, phytoplankton populations, larval fish, and fish eggs. This turbidity could be particularly harmful if it occurs during the spring spawning season. A related impact is the resuspension of pollutants during removal of pilings and other structures embedded in the sediment.

Shoreline erosion following the removal of structures is another problem. Not only would this cause the loss of terrestrial habitat and valuable shoreline, the resuspension of sediments could cause turbidity and could result in the resuspension of pollutants. Creosote on existing structures could act as a contaminant if allowed back into the water column during the removal of sources of drift.

Should structures be cut into smaller pieces prior to removal, the resulting sawdust could have adverse impacts on the aquatic environment. Layers of floating sawdust could impede light pentration, causing a reduction in phytoplankton and plant growth. Sawdust that is allowed to settle may alter the substrate and reduce the productivity of benthic macroinvertebrates.

Removal of dilapidated structures would also adversely affect fish and wildlife through the loss of shade, cover, nesting, and resting areas. However, the greatest impact on fish and wildlife could come from disposal operations. Landfill disposal will consume several acres of habitat that may be of value to fish and wildlife, depending on the area chosen. Burning of debris could increase air pollution in the area.

Beneficial Impacts of Drift and Debris Removal

There are some potential benefits to fish and wildlife from debris removal. Fish and Wildlife habitat could be improved if areas where structures are removed are allowed to revegetate naturally. Plantings of wildlife food and cover species would also improve the habitat. Some structures to be removed may include rock cribbing. Should this be the case, rocks could be piled in strategic locations, rather than scattered on the bottom. Scattering the rocks could harm the benthic community, while strategically piling them could create additional habitat for fish and invertebrates.

One possibility for disposal that was not discussed in your letter is the creation of artificial reefs. Clean structures could be tied together and anchored in an offshore area, providing excellent fish habitat. The one steel vessel to be removed from the harbor may also have potential as an artificial reef.

Discussion of Alternatives

There are four alternatives included in the drift and debris study. Each of these would include some of the adverse impacts on fish and

wildlife discussed above. The impacts involved with each alternative are discussed below.

Since Alternative I is the no action alternative, no new impacts, either adverse or beneficial, would occur. The only adverse impacts to fish and wildlife occurring under the present emergency drift removal program would be the loss of small quantities of invertebrate habitat and the minor loss of habitat from landfill operations which utilize the debris. These impacts are minimal. There are essentially no beneficial impacts on fish and wildlife with the existing program.

Alternative II, the continuous removal of floating drift, has slightly greater impacts than Alternative I, due to the larger quantities of material being removed, resulting in a greater loss of invertebrate habitat. However, this habitat loss would probably have a negligible effect on the ecological community of the Buffalo Harbor area.

Each of the three alternative disposal methods has a different impact on fish and wildlife resources. Alternative "a", destruction by a total mobile combustion unit, would have virtually no impacts, either adverse or beneficial, other than some air pollution. Alternative "b", re-use through burning to produce energy, would also have virtually no adverse impacts, other than any additional air pollution created by burning the debris. A potential beneficial effect on fish and wildlife would be the reduced energy need. Since this disposal method would provide energy, a certain amount of coal, oil, or wood that would otherwise be used to produce this energy could be saved. The acquisition of each of these three fuels involves the loss of some habitat. These benefits would be minimal, however. Alternative "c", the use of an existing sanitary landfill, would have no beneficial impacts on fish and wildlife resources, and would have the most adverse impacts. The major adverse impact would be the loss of the land used for the landfill. Depending on the type of habitat at the landfill site, this impact could be significant (i.e., several acres of wetland) or insignificant (i.e., an old mine). We would recommend that the Corps use an approved landfill that is not located in or near valuable fish and wildlife habitat.

Alternative III, a one-time cleanup of major sources of drift, has more adverse impacts than the two alternatives presented thus far. All of the adverse impacts discussed earlier would occur under this plan. These include the direct loss of habitat via debris removal and removal

of structures, loss of substrate during structure removal, resuspension of pollutants, turbidity, shoreline erosion, and the effects of sawdust and creosote on aquatic life. The only beneficial impacts associated with the cleanup of drift sources would be any habitat that is created via riprap, plantings, or natural revegetation of these areas. However, the habitat created is probably more than offset by the habitat lost. Since the disposal alternatives are the same as those in Alternative II, the impacts would be the same, only on a larger scale, due to the much larger quantities of material to be disposed of. We also feel the Corps should consider the fourth disposal alternative (artificial reef creation) discussed above. This alternative disposal method would have the most beneficial impacts on fish and wildlife resources.

Since Alternative IV, a one-time cleanup of major drift sources and an annual maintenance program, is essentially a combination of Alternatives II and III, the impacts would be the same as the impacts of these two alternatives combined. Therefore, Alternative IV has the most adverse impacts on fish and wildlife resources of the four alternatives presented.

Ranking of Alternatives

From a fish and wildlife standpoint, Alternative I is the best, since it has the least impacts. However, with proper mitigation measures (discussed below), the Fish and Wildlife Service could support any of the other three alternatives. None of the four alternatives would have severe adverse impacts on the fish and wildlife resources of the Buffalo Harbor Area, provided the material is properly disposed of and no pollutants are resuspended in the water column.

Mitigation Measures

A variety of mitigation measures should be undertaken to limit and compensate for the adverse impacts that this project will have on fish and wildlife resources. Sediments should be analyzed for pollutants before structures are removed to ensure that pollutants will not be resuspended in the water column. Care must also be taken during the removal and disposal of creosoted timbers. All sawdust should be contained and promptly removed. Any removal of structures which will disturb the sediments and increase turbidity should not occur during the fish spawning and nursery season (approximately April 15 through July 15 for those species present in the project area). Unstable shoreline areas should

be riprapped to prevent erosion following removal of structures. Wherever practical, natural or artificial revegetation should be used to restore habitat and prevent erosion. All debris should be recycled when possible, including the creation of artificial reefs from clean timbers and steel vessels. That material which cannot be recycled should be burned for energy or disposed of in an approved landfill.

Abandoned Grain Elevators

There are essentially no adverse impacts on fish and wildlife resources from the removal of grain elevators provided that the material is properly disposed of.

We appreciate the opportunity for input at this stage of the planning process. Please keep us informed of any further developments or decisions regarding this project.

Sincerely yours,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

cc:
NYSDEC, Albany, NY
NYSDEC, Buffalo, NY
NYSDEC, Olean, NY
EPA, New York, NY

ES, Cortland, NY:SPatch:PHamilton:pb

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
HARRISBURG AREA OFFICE
100 Chestnut Street, Room 310
Harrisburg, Pennsylvania 17101

September 4, 1980

Mr. Donald M. Liddell
Chief, Engineering Division
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Dear Mr. Liddell:

This responds to your letter (NCBED-PE) of August 11, 1980, requesting information on the presence of threatened or endangered species or critical habitat in the Buffalo Harbor Study Area, Erie County, New York.

Except for occasional transient individuals, no federally listed or proposed species under our jurisdiction are known to exist in the study area. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act is required with the Fish and Wildlife Service (FWS). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered.

This response relates only to endangered species under our jurisdiction. It does not address other FWS concerns under the Fish and Wildlife Coordination Act or other legislation.

A list of federally listed endangered and threatened species in New York is enclosed for your information. Please contact us if we can be of further assistance.

Sincerely,

Norman R. Chupp
Area Manager

Enclosure

TELEPHONE OR VERBAL CONVERSATION RECORD

For use of this form, see AR 340-15; the proponent agency is The Adjutant General's Office.

DATE: 7/14/81

SUBJECT OF CONVERSATION: Endangered Species in Buffalo Harbor Area

INCOMING CALL

PERSON CALLING	ADDRESS	PHONE NUMBER AND EXTENSION
PERSON CALLED	**OFFICE**	**PHONE NUMBER AND EXTENSION**

OUTGOING CALL

PERSON CALLING	OFFICE	PHONE NUMBER AND EXTENSION
Phil Frapwell	Environmental	
PERSON CALLED	**ADDRESS**	**PHONE NUMBER AND EXTENSION**
Dieter Bush	USF&WLS Harrisburg	

SUMMARY OF CONVERSATION

1. Informed Dieter of the addition of the Drift Removal Study under the Buffalo Harbor Study. Inquired if I would need to write another letter under Section 7 Endangered Species Act. Dieter told me no - project would not effect any critical habitat or endangered species and just make telephone memo and reference original letter on Buffalo Harbor dated 4 September 1980.

New York State Department of Environmental Conservation
Division of Regulatory Affairs - Region 9
600 Delaware Avenue, Buffalo, NY 14202-1073
(716) 847-4551

Robert F. Flacke
Commissioner

April 6, 1982

Mr. Charles E. Gilbert, Chief
Planning Division
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Attn. Mr. Thomas Swiatala

Re: Buffalo Harbor Drift and Debris Study

Dear Mr. Gilbert:

In response to your March 3, 1982 letter, please be advised that this Department favors the above-referenced study to determine the advisability of a federal project for the collection, removal, and disposal of drift and its sources in the Port of Buffalo and adjacent waterways.

Alternative IV consisting of a one-time cleanup program to rid the harbor of major sources of drift followed up by a formal annual maintenance program is recommended as the most effective solution to the problem of drift and debris in Buffalo Harbor. However, we are concerned with resuspension/disposal of contaminated bottom sediments excavated incidentally as a result of possible backhoe removal of piling for Alternative III and IV. Please note that per our Solid Waste Unit's review, none of the shorefront structures themselves appear likely to be contaminated with hazardous materials.

Although Alternative II consisting of continuous removal of floating debris during the recreational boating season on a yearly basis is not as thorough a solution as Alternative IV, it would not involve excavating contaminated bottom sediments.

The recommended means of drift disposal is by burning the debris at the Hooker Chemical resource recovery facility in Niagara Falls, New York, and we also favor that approach. The next preferable disposal method would be by incineration in a total mobile combustion unit. The combustion unit would require an Air Resources Permit from this Department. Since available local landfill space is at a premium, the landfill alternative would be the least preferable disposal method from our viewpoint. The Regional Solid Waste Unit should be notified of the haulers involved in transporting the debris and the ultimate disposal site of the debris in order to determine permit requirements (if any).

Thank you for the opportunity to review and comment on this study.

Respectfully,

Steven J. Doleski

Steven J. Doleski
Regional Permit Administrator

JED:jg

BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL

ENVIRONMENTAL ASSESSMENT

APPENDIX D

APPENDIX Dd

COMMENTS AND RESPONSES

This Appendix will be attached following public
and agency review of the report

APPENDIX E

THE BUFFALO HARBOR DRIFT AND DEBRIS REMOVAL STUDY

BUFFALO, NEW YORK

LEGAL ASSESSMENT

U.S. Army Engineer District, Buffalo
1776 Niagara Street
Buffalo, New York 14207

BUFFALO HARBOR
DRIFT AND DEBRIS REMOVAL STUDY
BUFFALO, NEW YORK

APPENDIX E

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BUFFALO HARBOR STUDY DRIFT AND DEBRIS

Appendix E

E1. PREFACE

The most prevalent sources of floating debris in Buffalo Harbor originate from tributaries and dilapidated waterfront structures. In addition to being obstructive and injurious to navigation, these sources are aesthetically unpleasant, and combined with the discharge of municpal and industrial wastes, are the contributing factor to the degradation of water quality in the harbor. Since the primary interest of this report is in solid floating debris and its effect on navigation, no reference will be made to legislation concerning liquid pollution and water quality standards except as the same may effect navigation.

The U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) are the primary Federal agencies with jurisdiction over the sources of debris. Acting in the interests of navigation, under the Rivers and Harbors Act of 1899, the Corps has jursidiction over any obstruction to navigation and any structure extending into, onto, or over navigable waters or which will affect the navigable capacity thereof. Under the Rivers and Harbors Act of 1899 and the Clean Water Act, EPA has jurisdiction over the discharge or deposit of pollutants and any refuse matter into waters of the United States other than that flowing in a liquid state from streets and storm sewers.

The New York State Department of Environmental Conservation (DEC) is the primary State agency charged with protection of the waters of New York State. DEC has jurisdiction over the littering of waterways, discharge of debris, refuse and pollutants into waters of the State, the erection of certain structures and work affecting stream beds and navigable waters.

A general survey of the two counties, five towns and five cities bordering Buffalo Harbor regarding the existence of local laws or ordinances pertaining to the sources of floating material, that only the cities of Buffalo and North Tonawanda and the Town of West Seneca have laws that could be used to combat drift.

The body of the report has been arranged in sections corresponding to the prevalent sources of debris. A discussion of the problem involved is followed by a historical background of Federal, State and local laws, regulations and decisions.

E2. WATERFRONT STRUCTURES

a. The Problem.

Any structure built on or over navigable waters is subject to a conflict between the property rights of the riparian owner, the right of the State or local Government to regulate such property in the interest of the general public, and the superior right of the Federal Government over navigable waters in the interest of navigation (navigational servitude).

A riparian proprietor has the right of access to the navigable part of the stream in front of his land and to construct a wharf or pier projecting into the stream for his own use or the use of others, subject to such general rules and regulations as the legislature may prescribe for the protection of the public. Webber vs. Board of Harbor Commissioners, 85 US 57. The question as to the extent and nature of the rights of riparian owners upon navigable waters is one to be decided by the courts of the State as a matter of local law, subject to the right of Congress to regulate public navigation and commerce. St. Anthony Falls Water Power Co. vs. Board of Water Commissioners of the City of St. Paul, Minn. 168 US 349.

While the maintenance, use, and operation of wharves, piers, and docks could be subject to Federal regulations under its power over navigation and commerce, there has been a reluctance to exercise this control in the removal of obstructions which do not directly affect navigation. As a practical matter, most of the existing deteriorated and dilapidated structures affecting Buffalo Harbor were built inside of harbor lines where they would have little direct effect on navigation. In the absence of Federal regulations which specifically encompass the subject, the position has been taken that such matters are of local concern, and are subject to State regulations, either directly by the State or through its municipalities or other governmental agencies.

The State of New York, under its regulatory power over navigable waters, has enacted legislation dealing with the permitting of waterfront structures, but none specifically related to dilapidated and deteriorated structures.

The Town of West Seneca has an ordinance dealing with unsafe buildings which allows the local government to remove or repair buildings that become dangerous or unsafe to the public. The cities of Buffalo and North Tonawanda have broader ordinances providing for the repair, demolition, or removal of buildings and structures which are abandoned dilapidated, deteriorated, decayed, or unattractive so as to endager the health, safety, or, welfare of the public.

b. Federal Laws and Regulations.

Section 10 of the Rivers and Harbors Act of 1899, 33 USC 403, states that it is unlawful to create any obstruction not affirmatively authorized by Congress to the navigable capacity of any of the waters of the United States. The building or commencement of building of any wharf, pier, dolphin, boom, weir, breakwater, bulkhead, jetty, or other structure in any navigable water

of the United States, outside established harbor lines, or where no harbor lines have been established, is also unlawful except on plans recommended by the Chief of Engineers and authorized by the Secretary.

Section 11 of the Rivers and Harbors Act, 33 USC 404, provides for the Secretary of the Army, where he deems it essential to the preservation and protection of harbors, to cause harbor lines to be established, beyond which no piers, wharves, bulkheads, or other works may be extended or deposits made, except under such regulation as he may prescribe.

Under Section 12, 33 USC 406, of the Rivers and Harbors Act, it is a misdemeanor to violate Sections 10, 11, supra, and on conviction thereof provides for punishment by fines and/or imprisonment. Section 12 also provides that the removal of any structure erected in violation of Sections 10 and 11 may be enforced by injunction.

Title 33 of the Code of Federal Regulations has provided for the issuance of permits by the Department of the Army for the construction of structures in or over navigable waters (33 CFR 322) and also for the revocation of these permits (33 CFR 325) for failure on the part of the permittee to comply with any conditions therein, or where the structures or other work constitutes an unreasonable obstruction to navigation or to operations of the United States in the interests of navigation or flood control.

Prior to 1970, riparian owners could erect open pile structures or undertake solid fill construction shoreward of established harbor lines without obtaining a permit in accordance with Section 10 of the Rivers and Harbors Act. This long standing policy created concern with the enactment of various pieces of environmental legislation, noted below, that contained a clear expression of the Congress' concern that the public interest may not have received sufficient scrutiny. To alleviate this concern and to insure that the public interest would be considered and protected, it was declared that all existing and future harbor lines were to be guidelines only with respect to navigation interests. It is now the policy of the Corps of Engineers to require the issuance of a permit pursuant to Section 10 in every instance of work commenced shoreward of any existing or future harbor line. See 33 CFR 328 generally on this subject.

Although the Corps of Engineers has certain regulatory powers under the Rivers and Harbors Act of 1899 and other laws for the protection and preservation of navigable waters, it has been long standing policy to secure compliance with the provisions short of legal proceedings. Prosecution is recommended in all cases of willful or intentional violations and all cases in which the parties responsible refuse or neglect to remove the unlawful structure or deposit or to make good the damages suffered. The exact procedures to be followed in the event activities are performed in the navigable waters without proper authorization are set out in 33 CFR 326.

It should also be noted that the Congress has prohibited the expenditure of appropriated money for dredging improvements inside of established harbor lines, 33 USC 628. It is against the rules of the Department of the Army to expend Federal funds for the removal of wrecks or other obstructions

shoreward of established harbor lines, 33 CFR 328. An Act of Resolution of the Congress authorizing clean-up work shoreward of any harbor lines would supersede the preceding policy statement.

Authority to fund harbor clean-up programs is contained in Section 202 of the Water Resources Development Act of 1976, Public Law 94-587, 90 Stat. 2917. Section 202(a) of this Act contains the Congressional finding that drift and debris on or in privately maintained commercial boat harbors, and the land and water areas immediately adjacent therto, threaten navigational safety, public health, recreation, and the harborfront environment. In response to this problem, Congress assigned responsibility for developing projects for the collection and removal of drift and debris from publicly maintained commercial boat harbors to the Corps of Engineers (Section 202(b)(1)). The Federal share of the costs of any project developed pursuant to this Act was set at two-thirds of the project cost except as outlined below. It is the responsibility of non-Federal interests to recover the full cost of drift or debris removal from any identified owner of piers or other structures or to require the repair of these sources so that they no longer create a potential source of drift or debris.

c. Federal Decisions.

The limits of Federal authority over navigable waters were outlined in the United States vs. Chicago, Milwaukee, St. Paul-Pacific Railroad Co., 312 US 592, where the Court held that the dominant power of the Federal Government over navigable waters extends to the entire "bed" of the stream, which includes the lands below ordinary high water mark and the exercise of the power within these limits is not an invasion of private "property right" in such lands for which the United States must make compensation, since the damage sustained results not from a taking of the riparian owners' property in the stream bed, but from the lawful exercise of a power to which the property has always been subject.

The Federal Government has extended its control shoreward of established harbor lines to include all waters in the Federal admiralty jurisdiction (33 CFR 322). However, this change has no effect on structures existing or completed under previously existing harbor line authority, as no permit is required for these structures. The net effect of the change in the harbor line regulation is that any old or dilapidated structures do not require a permit in order to remain in the navigable waters.

The application of Federal power over structures was stated in United States vs. Appalachian Electric Power Co., 311 US 377, where it was held that the United States has plenary power to exclude structures from navigable waters and dominion over flowage and water power inherent therein, and may make the erection or maintenance of a structure in a navigable water dependent upon a license. So, consequently, any structure in the bed of a navigable waterway is put there at the risk that it could be taken by the Federal Government at any time without compensation in the interest of navigation, provided that the taking was not arbitrary. United States vs. Martin, 177 F2d 733.

A riparian owner who had erected a wharf on the waterfront which conformed to the harbor lines as established by the State and adopted by the Federal Government, was not entitled to any compensation when Congress, in the exercise of its power over commerce, established a new harbor line which required the demolition of a portion of such wharf. Greenleaf-Johnson Lumber Co. vs. Garrison, 237 US 251.

The navigational servitude of the United States is all inclusive. The Supreme Court has said "Thus, having the power under the Commerce Clause to obstruct navigation by depositing the dredged solid in Willoughby Bay, the Government was likwise authorized to deposit in Mason Creek. There is power to block navigation at one place to foster it in another. (South Carolina vs. Georgia 93 US 4, Scranton vs. Wheeler 179 US 141 and Arizona vs. California 283 US 423). Whether this blocking be done by altering the streams course, by lighthouses, jetties, piers, or a dam made of dredged material, the Governments power is the same and in the instant case is derived from the same source - its authority to regulate commerce". United States vs. Commodore Park 324 US 386.

Even if the work in question is for Flood Control, it is subject to the Government's Navigational Servitude Coastal Petroleum Co. vs. United States 524 F2d. 1206 (1975) Cert. denied 101 SC 567.

All individual permits currently issued under Section 10 of the Rivers and Harbors Act of 1899, contain the following General Conditions:

"(h) That the permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings attached hereto."

"(q) That if and when the permittee desires tc abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition S hereof, he must restore the area to a condition satisfactory to the District Engineer."

"(s) That there shall be no unreasonable interference with navigation by the existence or use of the activity authorized herein."

which can be used to have deteriorated structures repaired or removed. Older permits do not necessarily contain these conditions.

E3. DILAPIDATED WATERFRONT STRUCTURES

a. State and Local Statutes and Decisions.

The State of New York has passed a number of laws for the protection of it's water resources. Section 32 of the Navigation Law of New York provides: "It shall be unlawful to construct, in the navigable waters of the state, any wharf, dock, pier, jetty, or other type of structure without first obtaining a permit therefor in conformity with the provisions of section four hundred twenty-nine-c of the conservation law."

Section 429 of the Conservation Law has been superceded by Section 15-0503 of the Environmental Conservation Law which provides:

" Except as provided in subdivision 4 of this section, no dam or impoundment structure, including any artifical obstruction, temporary or permanent, in or across a natural stream or water course, nor any permanent dock, pier, wharf, or other structure used as a landing place on waters, shall be erected, constructed, reconstructed, or repaired by any person or local public coporation without a permit issued pursuant to subdivision 3 of this section."

Section 15-0503 (4-c and d) provides exemptions from this permit requirement for:

"c. A dock, pier, wharf, or other structure under jurisdiction of the Department of Docks, if any, in a city or town of over one hundred and seventy-five thousand population;

"d. A dock, pier, wharf, or other structure built on floats, columns, open timber, piles, or similar open-work supports having a top surface area of two hundred square feet or less."

The State also has the power to control, license, or forbid structures in tributaries of navigable waters or in outlets therefrom, even if tributaries or outlets are themselves nonnavigable, if the structures have an effect upon the navigable waters. People vs. System Properties, 1953, 281 App. Div. 433, modified on other grounds 2 NY2d 330.

A riparian owner, owning property adjacent to navigable waters, has the right of access to the water, and this includes the right to construct a pier or dock; but this right is subordinate to the exercise of power of Legislature for improvement of navigation or for regulation of commerce. Crance vs. State, 1954, 284 App. Div. 750, reversed on other grounds 309 NY 680.

Each permit issued by the DEC contains the following General Condition:

"That if future operations by the State of New York require an alteration in the position of the structure or work herein authorized, or if, in the opinion of the Department of Environmental Conservation, it shall cause unreasonable obstruction to the free navigation of said waters, or flood flows, or endanger the health, safety, or welfare of the people of the State, or loss or destruction of the natural resources of the State, the owner may be ordered by the Department to remove or alter the structural work, obstructions, or hazards caused thereby without expense to the State; and if, upon the expiration or revocation of this permit, the structure, fill, excavation, or other modification of the watercourse hereby authorized shall not be completed, the owners shall, without expense to the State, and to such extent and in such time and manner as the Department of Environmental Conservation may require, remove all or any portion of the uncompleted structure or fill and restore to its former condition the navigable and flood capacity of the watercourse. No claim shall be made against the State of New York on account of any such removal or alteration".

This condition could be used by DEC to require repair or removal of a dilapidated or deteriorated permitted structure that becomes a hazard to navigation or the public health, safety, or welfare. Section 22A of Chapter XII of the city of Buffalo code requires:

"The owner of any building or structure, or any part or parts thereof, which becomes or is abandoned, dilapidated, deteriorated, decayed, or unattractive from any cause, so as to endnager the health, safety, or welfare of the public, shall repair, demolish, or remover same. (Ord. of 11-12-74)

If the owner fails to commence work within 30 days of proper notice to do so, the city has the right to repair or remove the structure and assess the costs thereof against the land.

Section 94-1 of the city of North Tonawanda code provides that:

"All buildings or structures or any part or parts thereof which become or are abandoned, dilapidated, decayed, or unattractive from any cause so as to endanger the health, safety, or welfare of the public shall be repaired, demolished, or removed."

North Tonawanda, like Buffalo, may do the work and assess the cost to the land if the owner fails to start work in 30 days of proper notice.

The town of West Seneca requires all buildings to be maintained (Section 92-6 of the West Seneca code). It also provides for the removal or repair of unsafe buildings (Chapter 57 of the West Seneca code) if necessary, by the town with costs assessed to the land.

E4. WRECKED AND ABANDONED VESSELS

a. The Problem.

Under general maritime law, the owner of a wrecked or sunken vessel has the right to abandon the wreck and be no longer responsible for its removal. That law has not been changed by the Rivers and Harbors Act of 1899 which fully recognizes the owner's right of abandonment. As a result, the duty of clearing wrecked and abandoned vessels has been imposed on the Federal Government. However, these duties have been restricted to navigable channels and in practice are not extended beyond channel lines, even though such waters are navigable waters. Title 33 of the Code of Federal Regulations, Section 209.190(a)(2), states:

"As removal by the United States without formal abandonment involves the taking of private property for public purposes, the provisions of the section of law applicable to the particular case must be followed strictly. Removal by the United States is not usually undertaken if the obstruction simply affects the approaches to private warves or canals and is not obstructing or endangering navigation.

When the United States has acted in removing a sunken vessel, the question of reimbursement from owner arises. In many cases the salvage value of the

vessel would be insufficient to cover the removal cost, especially where the vessels were intentionally sunk. Therefore, a distinction in the owner's liability must be made between vessels intentionally or negligently sunk and those sunk by accident; also there is the question of proof or negligence or intent.

Local legislation, in turn, suffers from the owner's right to abandonment since any restriction by the local government would be overruled by the Federal Admiralty Courts.

b. Federal Laws and Regulations.

Duties as to the removal of wrecked and abondoned vessels have been imposed by the Federal Wreck Statute, (33 USC Sections 409, 414, 415) which relates to the removal of a vessel, raft, or other craft wrecked and sunk in a navigable channel.

Section 409 makes it unlawful to voluntarily or carelessly sink, or permit or cause to be sunk, any craft in navigable channels so as to obstruct, impede, or endanger navigation. It also imposes upon the owner of the sunken craft the duty of marking the wreck with a suitable marker. This Section further provides for the immediate removal of the sunken craft by the owner; and his failure to remove it would be considered as an abandonment of such craft and subject the craft to removal by the United States.

Section 414 states that whenever a sunken vessel has been abandoned or has obstructed navigation for a period longer than 30 days, the sunken vessel shall be subject to be broken up, removed, sold, or otherwise disposed of by the Secretary of the Army at his discretion, without liability for any damage to the owners of the same and that any money received from the sale of such wreck, or from any Contractor for the removal of wrecks shall be deposited into the Treasury of the United States.

The remedy provided in Section 414 is to be exercised after the wreck has existed for a longer period than 30 days or the abandonment of such obstruction legally established in less time. Section 415 provides for summary removal of a wreck in cases of emergency. Under emergency, in the case of any vessel, boat, watercraft, or raft, or similar obstruction, sinking or grounding, or being unnecessarily delayed in any navigable waters in such manner as to stop, seriously interfere with, or specially endanger navigation, the Secretary of the Army shall have the right to take immediate possession of such boat, vessel, or other water craft or raft, so far as to remove or to destroy it and to clear the navigable waters. Section 415 also provides that the expense of removing the obstruction shall be a charge against the craft and its cargo. If the owner fails or refuses to reimburse the United States, then as under Section 414, the sunken craft or cargo could be sold limiting the maximum recovery to the proceeds of the sale.

Section 411 of Title 33 USC provides a penalty for the wrongful obstruction of navigable waters by making every person and every corporation that violates Section 409 guilty of a misdemeanor punishable by a fine of up to $2,500 and/or up to 1 year's imprisonment in the case of a natural person.

At this point is should be noted that under the preceding statutes the maximum liability of an owner of a sunken craft would be limited to an in rem charge against the craft and its cargo and the owner's possible criminal liability of a misdemeanor under Section 411. The statutes are silent, however, regarding any personal liability on the part of the owner for the cost of removal where the craft was deliberately or negligently sunk.

Under Title 33 of the Code of Federal Regulations, Section 209.170, a distinction was made between the liability of an owner of a vessel sunk without his fault and that of an owner of a vessel, negligently or willfully sunk. This regulation provides as follows:

"By the maritime law, the owner of a vessel which is sunk without fault on his part, may abondon the wreck in which case he cannot be held responsible for removing it even though it obstructs navigation. That law has not been changed by sections 15, 19, and 20 of the Rivers and Harbors Act of March 3, 1899 (30 Stat. 1152, 1154; 33 USC 409, 414, 415), which fully recongize the owner's right of abandonment. However, a person who willfully or negligently permits a vessel to sink in navigable waters of the United States may not relieve himself from all liability by merely abondoning the wreck. He may be found guilty of a misdemeanor and punished by a fine, imprisonment, or both, and, in addition, may have his license revoked or suspended. He may also be compelled to remove the wreck as a public nuisance or to pay for its removal".

c. Federal Decisions.

Of the main source of hazardous debris, the one receiving most consideration by the Federal Courts in recent years relates to wrecked and abandoned vessels. Some of the more pertinent recent decisions are discussed below in chronological order.

In the United States vs. Zubik, 295 F2d 53, decided in 1961, The U.S. Court of Appeals, Third Circuit affirmed a lower court decision granting the owner's motion to dismiss a complaint by the United States to recover the cost of removing a wrecked vessel obstructing a navigable river. According to the facts, the owner had negligently sunk two towboats in the Allegheny River in such a manner as to obstruct navigation. Five years after the sinkings and after Zubik had failed to comply with its demand to remove the vessels, the United States removed the wreckage. The Government then brought suit to recover the $3,273.83 incurred in removal cost alleging that the wrecks were valueless. The Court held that the United States could not recover the expenses of removal in the absence of an expressed or implied provision. The right accorded to the United States by the Rivers and Harbors Act to remove wrecks in navigable waters is in the nature of an in rem right against the vessel and not in personam right against the owner.

In 1963, the Ninth Circuit, United States Court of Appeals, in the case of United States vs. Bethlehem Steel Corp., 319 F2d 512, again affirmed a lower court decision dismissing the claim of the United States for the costs ($336,000, after salvage) of removing a sunken ship from a navigable channel.

The Court of Appeals held that the ship owner, which by its alleged negligence caused the ship to sink in the channel where it would, until removed, constitute an obstruction to navigation, was not liable under either the common law or the Rivers and Harbors Act to the United States for cost incurred by the United States in removing the ship from the channel.

The Court then went on to hold that the regulations (33 Code of Federal Regulations, Section 209.170) promulgated on behalf of the Corps of Engineers, requiring an owner to pay for removal of a vessel which he has willfully or negligently permitted to sink in navigable waters of the United States, is not authorized by the Rivers and Harbors Act of 1899. The last sentence of this regulation. "He may also be compelled to remove the wreck as a public nuisance or to pay for its removal" would solve the problem. But what it said was contrary to judicial decisions at the time the regulation was issued, and was, if we are correct in our estimate of what the statutes mean, an unauthorized effort to administratively improve the statute.

In 1964, an action was brought in the United States District Court, Maryland, to determine again the liability of an owner whose vessel had been intentionally grounded in navigable waters. In this case, United States vs. Bethlehem Steel Company and Moran Towing and Transportation Company, 235 F. Supp. 569, the vessel involved was a floating drydock. The Court held for the United States on the grounds that this drydock was not a "vessel or other craft" within the statute (33 USCA 409, 414, 415) permitting an owner to abandon his sunken vessel and limit his liability for the cost of removal to liability in rem against the vessel and the cargo, but that this case was controlled by Sections 403 and 406 (unauthorized obstructions to navigation). The Court then went on to state:

"If it were necessary for the decision of this case, the Court would hold that under Section 409 a distinction should be made between vessels which are deliberately or voluntarily sunk on the one hand and those which are accidently or negligently sunk on the other. As stated above, the statutes and the weight of authority indicate that Congress intended to protect the owners of vessels from personal liability for the expense of removing the wreck after they have had the misfortune of losing their boat or their ship; that consideration does not apply to an owner who voluntarily scuttles his vessel. If Section 409 should be construed to remove all vessels and other craft from the ambit of Section 403, Section 409 itself, when considered in the light of its purpose, should not be construed as absolving from in personam liability an owner who voluntarily scuttles his vessel".

In February of 1967, the United States Circuit Court of Appeals, Fourth Circuit (374 F2d 656) reversed the above decision of the District Court by holding that a floating drydock was a vessel within the meaning of the Wreck Act so as to make available to the owner the statutory right of abandonment.

The Supreme Court (389 US 575) granted the petition for a writ of certiorari in January 1968. The judgments of the Court of Appeals, Fourth Circuit, were vacated and the cause was remanded to that Court for further proceedings in light of a recent Supreme Court decision in Wyandotte Transportation Co. vs. United States, 389 US 191.

In Wyandotte Transportation Co. vs. United States, decided December 1967, two cases, United States vs. Cargill and United States vs. Wyandotte Transportation Co., involved related issues and were consolidated by the District Court for Eastern Louisiana.

The brief facts of the Cargill libel alleges that a super-tanker heading up the Mississippi for Baton Rouge collided with two barges owned by the petitioner and sunk them. The Government was notified immediately and a few days later was served with notice that the barges were being abandoned. The United States refused to accept abandonment or to assume responsibility of removal, charging that negligence in the equipping, manning, and mooring of the barges had caused the sinking.

In the Wyandotte libel, a barge loaded with 2,200,000 pounds of liquid chlorine sank while being pushed in the Mississippi. The owner of the wreck made some attempt to raise it but was unsuccessful. He then informed the Army Corps of Engineers that further attempts would be unsuccessful and that he was abondoning the vessel. The Government feared that if the chlorine escaped in the form of lethal chlorine gas it might cause a large number of casualties. After a demand by the Government and refusal by the owner, the United States successfully removed the barge at a cost of $3,081,000. The Government demanded reimbursement for its expenses and brought suit in rem against the barge and its cargo, and in personam against the owner of the barge charging negligence. The suits were dismissed in District Court and then appealed to the United States Court of Appeals for the Fifth Circuit, 367 F2d 971. The Circuit Court held that it is only innocent owners who may abandon a sunken ship which obstructs navigation; owners of negligently sunken barges obstructing navigation can not abandon them with impunity. Further, that the Government can compel negligent parties to remove the sunken vessels or pay the cost of removal.

Certiorari was granted by the Supreme Court, 389 US 191, where finally it was held that in view of the inadequacy of the criminal penalties in the Rivers and Harbors Act respecting violation of the section rendering it unlawful to carelessly sink a vessel in navigable channel, the United States may seek an order that the negligent party is responsible for a wrong done to maritime commerce by a statutory violation and may maintain a civil action against the parties responsible for the negligent sinking to recover the Government's expenses in removing the negligently sunk vessel.

d. State and Local Statutes and Decisions.

In New York, the statutes (Sections 130-149, Navigation Law) make no reference to "abandoned vessels," as such. Throughout these sections, the words used are "wrecked property," the word "wreck" being used in its broad sense to mean goods cast upon the land by the sea after a shipwreck. Sections 130-139 empower the sheriff of any county in which wrecked property is found to take possession thereof, to hold same, unless perishable, for the account of the owner for a period of 1 year and to dispose of same by sale if no owner is found or claim is made. The costs are defrayed from the sale of the property. These statutes deal primarily with the salvage of wrecked cargoes and vessels, there are no New York Statutes dealing with removal or

disposal of derelict or abandoned vessels. Also, there are no known local laws dealing with removal or disposal of derelict or abandoned vessels.

E5. DEBRIS DUMPED IN THE HARBOR AND ALONG THE SHORE

The sources of debris due to dumping in the harbor are refuse dumped along the shore of the harbor and its tributaries, shoreline demolition, refuse spilled during transshipping operations, and general refuse litter contributed by recreational and commercial vessels. There is also evidence of the accumulation of debris from the Buffalo sewerage system which was constructed prior to the use of separate systems for surface runoff, and although recently modernized, can still result in direct overflows into harbor waters during periods of heavy rains.

However, Section 13 of the Rivers and Harbors Act of 1899, 33 USC 407, which pertains to deposit of refuse in navigable waters generally, has exempted the discharge of material flowing from streets and sewers passing therefrom in a liquid state. The discharge of those materials is specifically dealt with under the general desire for clean water through the Clean Water Act, 33 USC 1251 et seq.

In substance, Section 13 states that it shall not be lawful to deposit, or cause, suffer, or procure to be deposited material of any kind on the banks of navigable waters, where the same shall be liable to be washed into the waters and impede or obstruct navigation. The statutory language needs some clarification here since it raises the question of whether a riparian owner could be a violator for permitting objectionable material, which was washed up on his bank to remain or whether there must be an active act on the part of the violator. This program has now been effectively delegated to New York State.

In addition the State has its own restrictions on dumping in navigable waters as do the cities of Buffalo and North Tonawanda.

a. Federal Laws and Regulations.

In the past, Federal legislation regulating the use of navigable waters as depositories of debris has been confined to preventing impediments to navigation, but with the passage of the Federal Water Pollution Control Act Amendments of 1972 that concern has been expanded to include the general maritime environment. 33 USC Sec. 1251 et seq.

In substance, Section 13 of the Rivers and Harbors Act of 1899, 33 USC 407, provides that it is unlawful to discharge or deposit into the navigable waters of the United States any refuse matter of any kind, other than that flowing from the streets and sewers and passing therefrom in liquid state, or to deposit, cause, suffer, or procure to be deposited material of any kind in any place on the bank of any navigable water, or tributary thereof, which may be washed into the navigable water, either by ordinary or high tides, or by storms or floods, or otherwise, whereby navigation shall or may be impeded or obstructed.

Section 13 also enpowers the Secretary of the Army to permit the deposit of any material in navigable waters whenever, in the judgment of the Chief of Engineers, anchorage and navigation will not be injured thereby. However, this permit program was terminated upon the passage of the Federal Water Pollution Control Act Amendments of 1972, and is now carried out by the Administrator of the Environmental Protection Agency under Section 402 of the Clean Water Act 33 USC 1342 who has delegated the program to the State of New York in accordance with 33 USC 1342.(b)

Protection of navigation was again made the limited objective of Section 419, Title 33, USC, which enpowered the Secretary of the Army to prescribe regulations governing the transportation and dumping into navigable waters of dredgings, earth, garbage, or other refuse material, whenever in his judgment such regulations are required in the interest of navigation.

Violation of the above statutes (407 and 419, Title 33, USC) is a misdemeanor and punishable under Section 411 by a fine of up to 25 hundred dollars and/or by imprisonment of up to 1 year (in the case of a natural person).

b. Federal Decisions.

Most Federal decisions involving the violation of Section 13 of the Rivers and Harbors Act pertain to the illegal deposits of solid fill, garbage, oil, and other liquid pollutants. The case of United States vs. New York Central and Hudson Pile Driver No. 2, 239 F 489 is one of the few cases involving drift that is obstructive or injurious to navigation.

Pile Driver No. 2 was engaged in repairing a ferry rack at the foot of West Forty-Second Street, NY. Lying alongside the pile driver was a raft containing piles which were too long for use and a man was engaged there in cutting them off and shoving the discarded ends into the river. This was done in three instances when the man was hailed by an inspection boat and the third piece was hauled back onto the raft. The discarded pieces were picked up by the patrol boat and were, respectively, about 20 feet and 13 feet long and 7 inches in diamerer. The Circuit Court of Appeals, Second Circuit, affirmed a lower court decision that clearly these timbers were or might become a serious menace to navigation. Floating about in the crowded waters of the harbor of New York in the night as well as the day, they might easily be caught by the propeller wheels of vessels, thus endangering life as well as property.

c. State and Local Statutes and Decisions.

The State of New York has enacted legislation to cope with the problem of deposits of solid waste refuse and garbage into its waters.

Section 33 of the Navigation Law makes it a misdemeanor to deposit garbage or other putrid or offensive matter into navigable waters of the State, except as authorized by the State Department of Health.

Section 33-c of the Navigation Law makes it a misdemeanor to discharge or deposit any solid material which render the water unsightly, noxious, or

otherwise unwholesome and makes it an offense to deposit or discharge litter into the water.

Article 17 of the Environmental Conservation Law prohibits the pollution of the waters of the State by, among other things, the discharge of organic or inorganic matter into the water where it will contribute to the contravention of State water quality standards or the discharge of pollutants, defined to include solid waste, from a point source into State waters.

The cities of Buffalo and North Tonawanda have ordinances prohibiting littering of public lands. In addition, the city of Buffalo prohibits the deposit of dirt, rubbish, or other material into any stream or natural water course and the littering of any private property without the permission of the owner.

BUFFALO HARBOR NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX F
CULTURAL RESOURCES

BUFFALO HARBOR NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX F
CULTURAL RESOURCES

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BUFFALO HARBOR NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL
BUFFALO HARBOR, BUFFALO, NEW YORK

APPENDIX F
CULTURAL RESOURCES

F1. INTRODUCTION

In August-October 1981, Buffalo District personnel conducted a cultural resources literature search for Buffalo Harbor and the upper Niagara River shoreline. The following is a summary of the report which resulted from that literature search, primarily that part which concerns the mapping and prediction of potentially sensitive archaeological and historic areas.

F2. SUMMARY OF SENSITIVE ARCHAEOLOGICAL AREAS

The study area has had a long history of occupation and use by Native Americans from at least the Early Archaic Period. Actual Paleo-Indian habitation sites have not been recognized within the study area, but it is quite possible that they exist. Areas most likely to contain Paleo-Indian sites are the locations of glacial lake beach ridges and locations where mastadon bones have been found.

Archaic sites have been reported in both Erie and Niagara Counties. Sites of the Archaic phases, particularly the Late Archaic, have been found concentrated along creeks flowing into Lakes Erie and Ontario, at the confluence of streams and along stream banks, on inland knolls, near marshes and swamps, and on the terraces along the Niagara River.

Early Woodland sites, particularly of the Meadowood Phase, have been reported in both counties; they are especially concentrated in Erie County. A major concentration of sites is found on the eastern shore of Grand Island, where excavations have produced considerable information on the Meadowood in Western New York. In particular, Meadowood sites are found to be associated with fossil glacial lakes, marshes, and riverine areas, such as the Niagara River.

Middle Woodland sites have been found concentrated along the lake plains, adjacent to rivers or large creeks, and in stream valleys penetrating the Allegheny Plateau. Several sites have been excavated and tested, including several on Grand Island. Nearly all were adjacent to the Niagara River and were fishing camps.

Although Late Woodland sites may be present within the study area, these sites are more likely to be found in Central Erie County, such as in Clarence, Lancaster, or Elma; that is, in areas where village movements have been identified. There also may be Late Woodland sites present either on stream terraces, in the uplands, or along the lower Niagara River in the vicinity of Lewiston.

It is possible to develop a model of prehistoric sensitivity areas for Native American cultural resources that are present in Western New York by taking into consideration topography, physiography, and the distribution of known sites throughout the cultural sequence. Based on previous studies, criteria have been developed to determine whether areas are of high or moderate sensitivity (ENCRPB, 1977). The model for these criteria are presented in Tables 1 and 2.

High sensitivity areas are those which are near water, contain elevated or well-drained terrain, are generally similar to areas which are known to contain sites, are near known concentrations of sites, or any combination of these factors. Moderate sensitivity areas may be further away from water, are flatter but otherwise appear to have potential for sites, or based on data from other areas, appear to be likely locations. Areas of low sensitivity are locations which are unlikely to contain sites, or areas for which there is little or no data to judge their potential. Sensitive archaeological zones within the study area are indicated in Figures F1 and F2.

F3. SUMMARY OF SENSITIVE HISTORIC AREAS

Historic sensitivity in Erie and Niagara Counties is seen along coastal areas, often at river/Lake Erie and Ontario interface (see Figure F3). A second pattern emerges along the axis of the Erie Canal. The Buffalo/Black Rock area became an important lake port, and the commercial and industrial center of Western New York. North, along the Erie Canal, was the major axis of population and settlement; southward on the Lake Erie coastal plain communities were founded to meet the needs of rural, agricultural pursuits (ENCRPB, 1977).

Within the project area, two major concentrations of historic sensitivity occur. One is at the junction of the Scajaquada Creek and the Niagara River where the Black Rock Harbor developed as the early focus of commercial activity. The second concentration is within the Buffalo Harbor Study Area (see Figures F4 and F5 and Table F3). Historic sensitivity within the harbor area is associated with those areas where early settlement occurred, where Erie Canal activities met lake shipping (i.e., Erie Canal Basin, Prime Slip, Commercial Slip), and those areas associated with the development of grain elevators and military activities.

F4. CONCLUSIONS

If the project is continued and a specific alternative is selected as the final plan, a more intensive archaeological survey, to include site testing, is recommended due to the abundance of historical and archaeological sensitivity within the project area. The exact extent, location, and nature of further cultural resources investigations will be formulated in consultation with the State Historic Preservation Officer and the National Park Service once the details fo the final plan are made available. More intensive archaeological investigations will require the services of a qualified archaeologist.

Table F1 - Prehistoric Economic Activity, Site Types, and Site Locations

Period	Subsistence Base	Site Types	Site Locations
Paleo-Indian (10,700 B.C. to 7000 B.C.)	Hunting, probably caribou, mastodon, moose-elk; smaller game; gathering available plants.	Camps, quarry-workshops, hunting stations.	Moraines and glacial lake strand lines; elevated topographic features; vantage points for game movements.
Archaic (7000 B.C. to 2000 B.C.)	In general, utilization of seasonally available resources; seasonal movements and occupation to exploit available resources; process of addition of new subsistence items to exploit during the period. Forest, lake, and stream ecology. General use of deer, small game, birds, fish, nuts, plant collection.	Temporary hunting camps; impermanent base camps.	Inland from large waterways, on small streams, on marshes, on large bodies of water.
Brewerton (3000 B.C. to 2000 B.C.)	Hunting of deer, elk, moose, beaver, bear; fishing; less adaptation to gathering.	Temporary hunting camps; impermanent base camps.	Large and small streams, marshes, large springs.
Lamoka (5000 B.C. to 2500 B.C.)	Acorn collection and fishing the most important, with hunting of less importance than in other Archaic economies.	Temporary hunting camps; impermanent base camps.	Large and small streams, lakes, and large marshes, forested bottomlands, terraces.
Transitional (1800 B.C. to 1000 B.C.)	Riverine adaptation based on hunting, fishing, gathering; deer, turkey, small animals.	Hunting and small fishing camps.	Low-lying areas, alluvial terraces, near streams and marshes. Inland and on waterways.
Early Woodland (1000 B.C. to A.D. 100)	Hunting, fishing, plant collection and preparation; apparent absence of seasonal rounds, with people staying on major waterways.	Camps, cemeteries, central base camps. More stable settlements than previously.	Along rivers, streams, lakes.

Table F1 - Prehistoric Economic Activity, Site Types, and Site Locations (Cont'd)

Period	Subsistence Base	Site Types	Site Locations
Middle Woodland (A.D. 100 to A.D. 1000)	Hunting (deer, bear, turkey, waterfowl, small animals); fishing; plant collection and processing.	Recurrently occupied camps (small and seasonal, large and semi-permanent); temporary small camps; cemeteries; burial mounds, workshops.	Adjacent to rivers and large creeks; lake margins; marshes.
Late Woodland (A.D. 1000 to A.D. 1600)	Horticulture, cultivation of corn, beans, squash; hunting, fishing, plant collection and processing.	Semi-permanent villages; semi-permanent hamlets; camps; ceremonial dumps; cemeteries and ossuaries; workshops.	Away from major streams; near small creeks; marshes and springs; on high hills and knolls especially defensible terrain near fertile bottomland.

SOURCE: Cultural Resources Management Services, Inc. (June 1977).

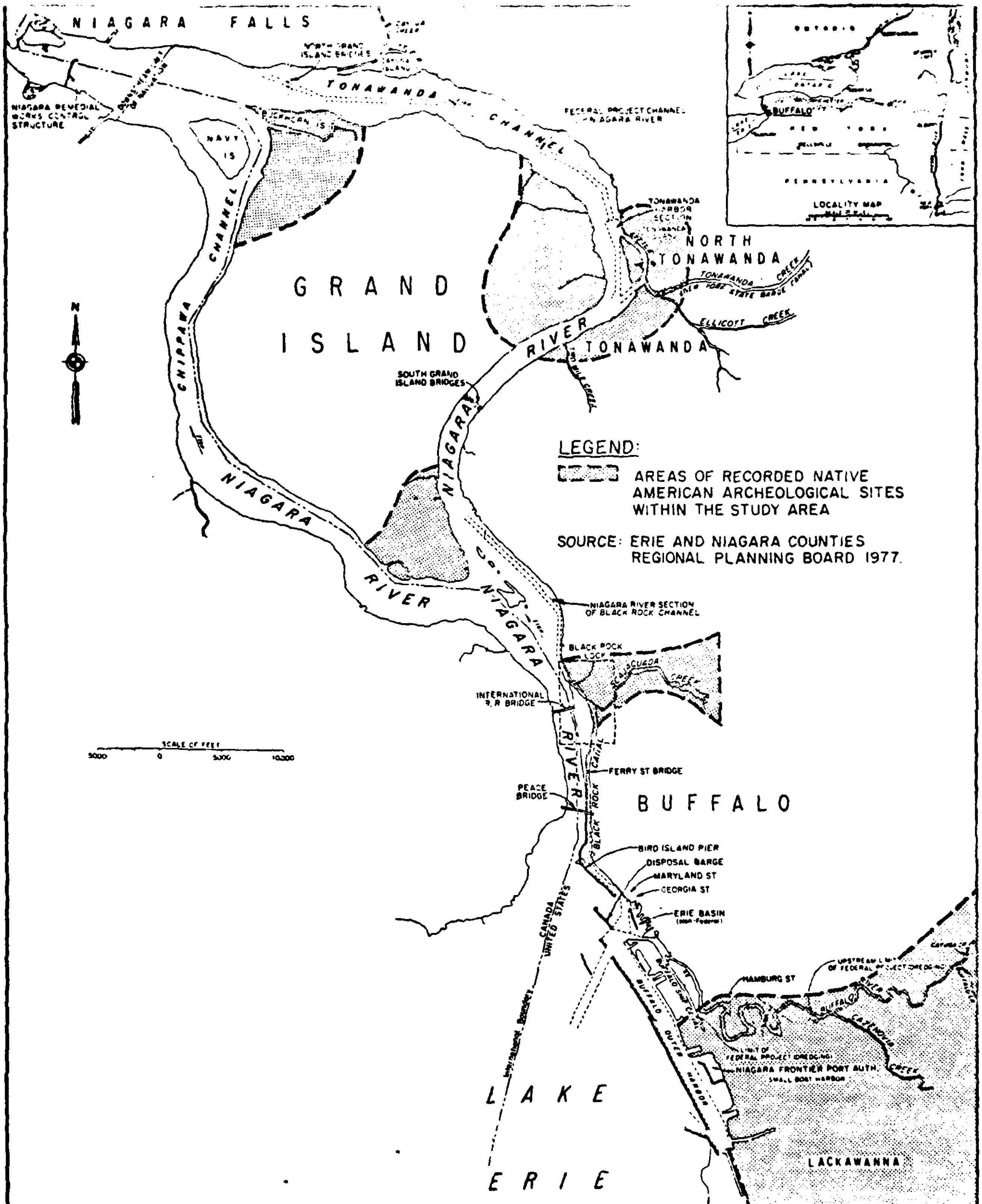
ENCPB, 208 Areawide Wastewater Treatment Management and Water Quality Improvement Program.

Table F2 - Model of Prehistoric Sensitivity Analysis

Sensitivity	Environmental Zone	Topographic Features	Site Types and Periods
High	Riverine lowlands - areas near creeks and streams - within approximately 2,000 feet of water source.	Terraces, knolls, banks.	Archaic and Transitional camp sites; Early and Middle Woodland camp sites, possible recurrently occupied; Late Woodland camps and villages, burial areas associated with villages.
	Marshes and lake remnants within approximately 1,000 feet of water source.	Knolls or higher areas within and at borders of marshes.	Paleo-Indian camps near lake remnants; Archaic and Transitional camps; Early and Middle Woodland camps, possibly recurrently occupied; Late Woodland camps and villages.
	Specific topographic features such as beach ridges, moraines, kames, water falls.	Specific topographic features such as beach ridges, moraines, kames, water falls.	Paleo-Indian camps; Archaic camps; Early through Late Woodland camps, villages, and cemeteries.
	Chert or flint outcrops.		Paleo-Indian through Late Woodland quarries and quarry-workshops.
	Defensible terrain.	Intersections of main stream valleys and secondary streams, high bluffs, particularly with ravines on several sides.	Archaic camps, particularly Laurential; Lake Woodland fortified villages and earthrings.
Moderate	Backcountry - away from streams - more than 3,500 feet from water source.	Knolls, level but well-drained areas.	Archaic camps, particularly Laurentian; Transitional camps; isolated finds of all periods.
Low	Low and very wet areas; steep slopes.	Lowlands.	Isolated finds of all periods.*

*Isolated finds and limited activity areas (flint chippage concentrations or flint debitage and tool concentrations, etc., indicative of very transitory utilization of a site) may be found for all periods and in many topographic features. They are indicative of hunting patterns, territories and other movements by prehistoric people. In combination with other site types, they provide data on the total settlement patterns and systems of prehistoric groups.

SOURCE: Cultural Resources Management Services, Inc. (June 1977).
ENCRPB, 208 Areawide Wastewater Treatment Management and Water Quality Improvement Program.

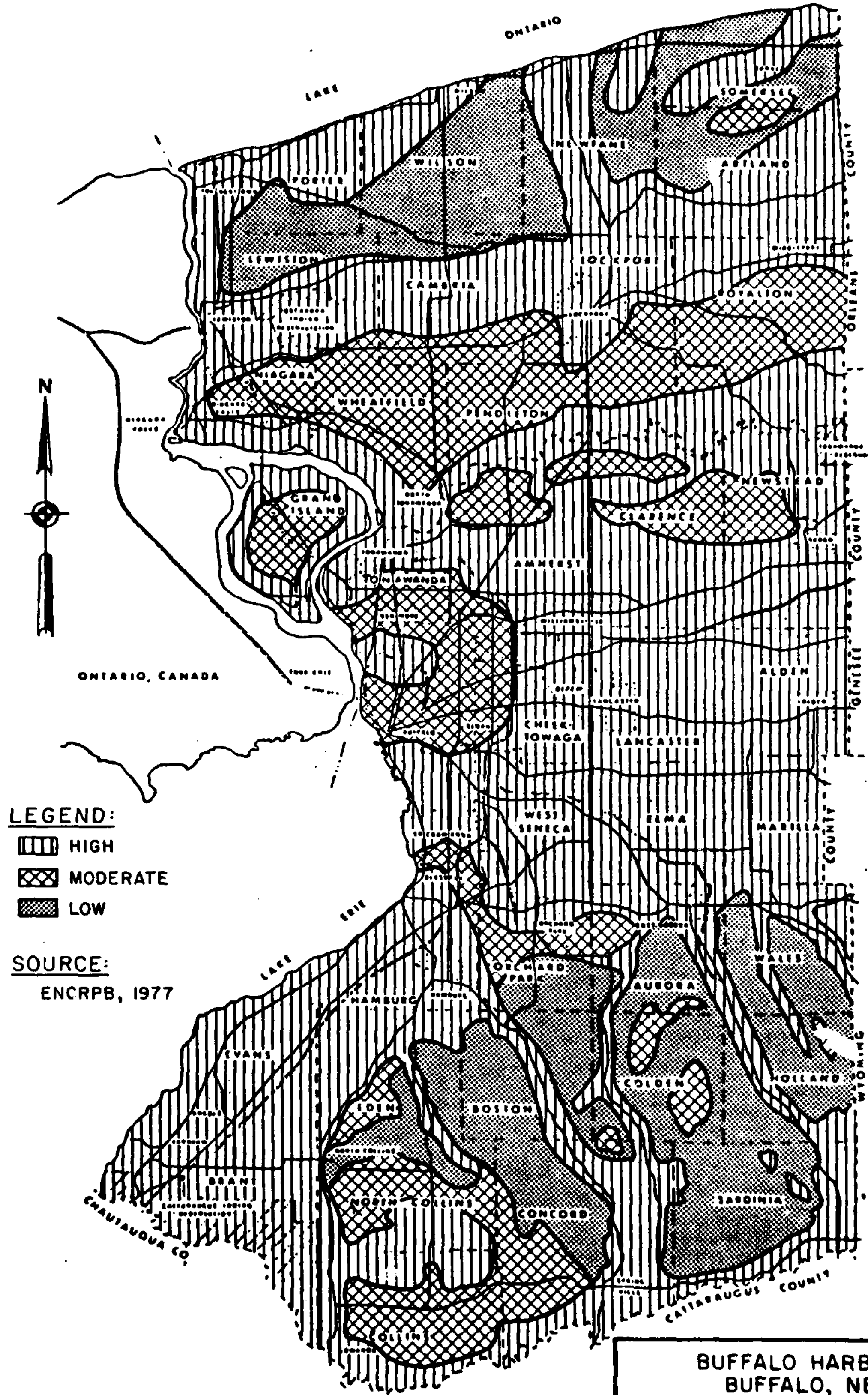


BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

NATIVE AMERICAN ARCHEOLOGICAL SITES

U.S. ARMY ENGINEER DISTRICT BUFFALO

FIGURE F1



NOTE:
PROBABILITY OF UNKNOWN NATIVE AMERICAN ARCHEOLOGICAL SITES

BUFFALO HARBOR STUDY
BUFFALO, NEW YORK

PROBABILITY OF UNKNOWN SITES

U.S. ARMY ENGINEER DISTRICT BUFFALO

FIGURE F2

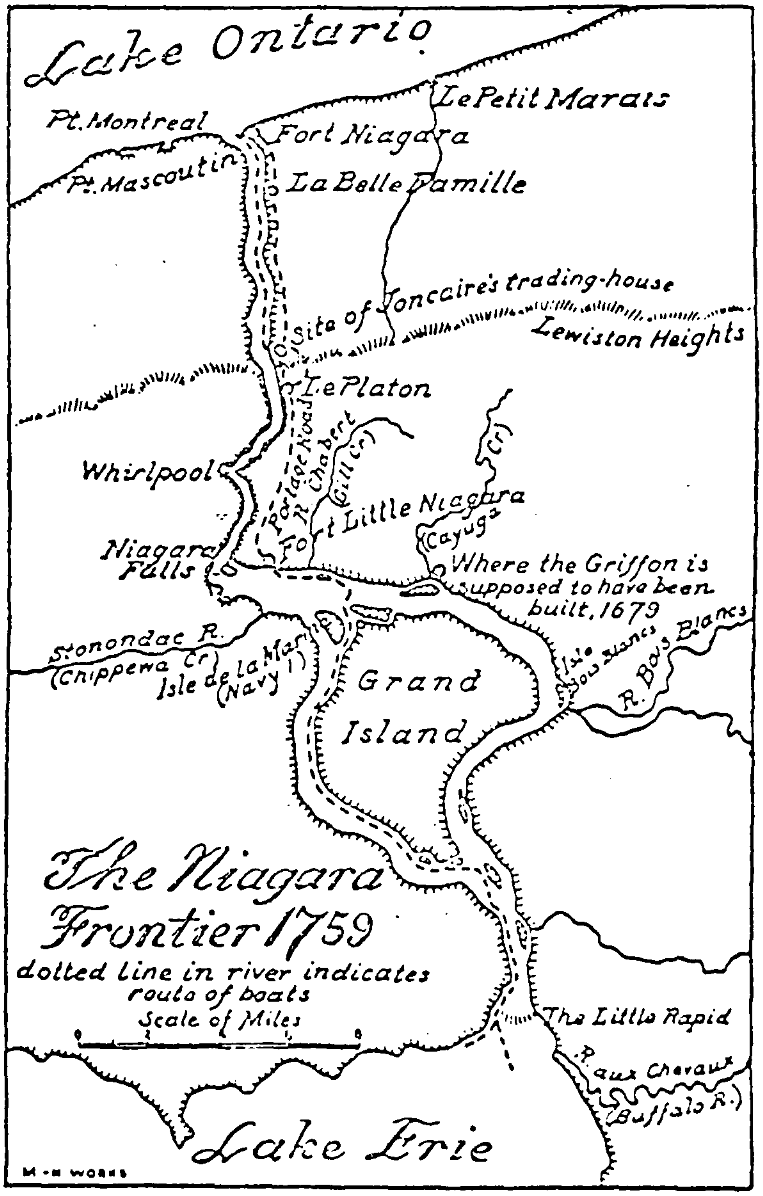


FIGURE F3

Source: Cultural Resource Management Services, 1977

BUFFALO HARBOR NAVIGATION STUDY
DRIFT AND DEBRIS REMOVAL

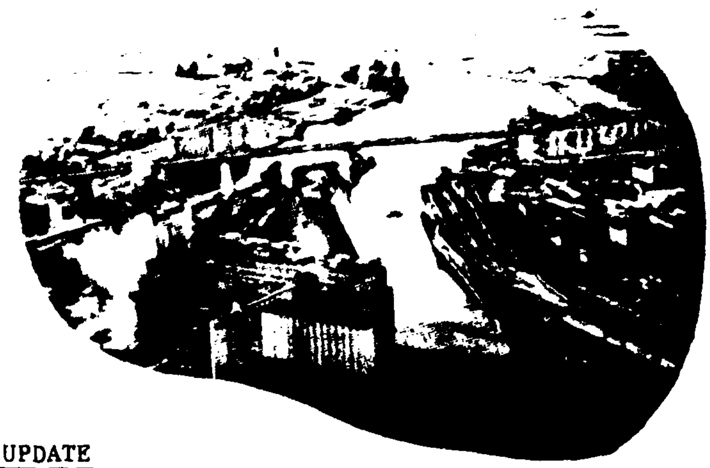
Buffalo Harbor, NY

APPENDIX G
CORRESPONDENCE

APPENDIX G
CORRESPONDENCE

EXHIBIT	DESCRIPTION
G-1	July 1982 News Update on the Drift and Debris Removal Study sent out to all participants in the Buffalo Harbor Study.
G-2	6 April 1982 letter from Steven J. Doleski of the New York State Department of Environmental Conservation commenting on the Drift and Debris Study.
G-3	31 March 1982 letter from Paul P. Hamilton of the U.S. Fish and Wildlife Service, Planning Aide Letter.
G-4	2 September 1982 letter from William Marcy Jr. of the Council, City of Buffalo requesting the Corps to consider the debris problem in the downstream area of the Scajaquada Creek.
G-5	24 August 1982 letter from John C. Loffredo of the Department of Public Works, City of Buffalo encouraging the Corps in the study and also requesting the Corps to examine the debris problems in the downstream area of the Scajaquada Creek.

Buffalo Harbor Study



NEWS UPDATE

July 1982

During the course of the Buffalo Harbor Study, it is our intention to keep you advised of our progress on the study and notify you of any major developments. This news update deals specifically with the Drift and Debris Removal Study, which is a supplemental study that will appear as an appendix to the Buffalo Harbor Preliminary Feasibility Report. It should be emphasized at the outset that the drift and debris study is a supplementry effort to the Buffalo Harbor Study, and that it is being done to provide additional information on the study area.

The purpose of the Drift and Debris Removal Study is to determine the feasibility of establishing a Federal project for the collection, removal, and disposal of drift in Buffalo Harbor and the adjoining waterways. Attachment No. 1 illustrates the geographical area under consideration. The study will also investigate the feasibility of removing the sources of drift. The major sources of drift have been identified as tributary drift from the Buffalo River, waterfront structures such as abandoned buildings, docks, piles, piers, and loose onshore debris.

The problem with drift in the Buffalo Harbor is that it constitutes a menace to small boat navigation. Boat operators must exercise care in navigating the waterways to avoid striking the drift. The greatest difficulty for small boat navigation is experienced at night or during fog conditions when the drift is difficult to see.

There were four alternative solutions identified in the early stages of the study. These four alternative solutions are presented below:

Alternative I. This is the no-action alternative. The base case against which all the other alternatives may be compared.

Alternative II. Establish a program for the continuous annual removal of drift in the harbor during the boating season.

U.S. ARMY ENGINEER DISTRICT, BUFFALO
1776 NIAGARA STREET
BUFFALO, N.Y., 14207

AD-A129 189 BUFFALO HARBOR STUDY PRELIMINARY FEASIBILITY REPORT VOLUME II APPENDICES(U) CORPS OF ENGINEERS BUFFALO NY BUFFALO DISTRICT APR 83

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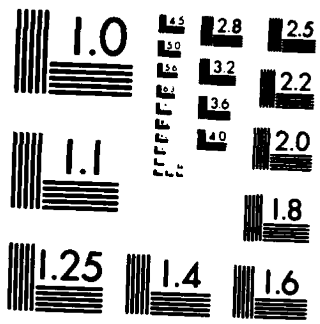


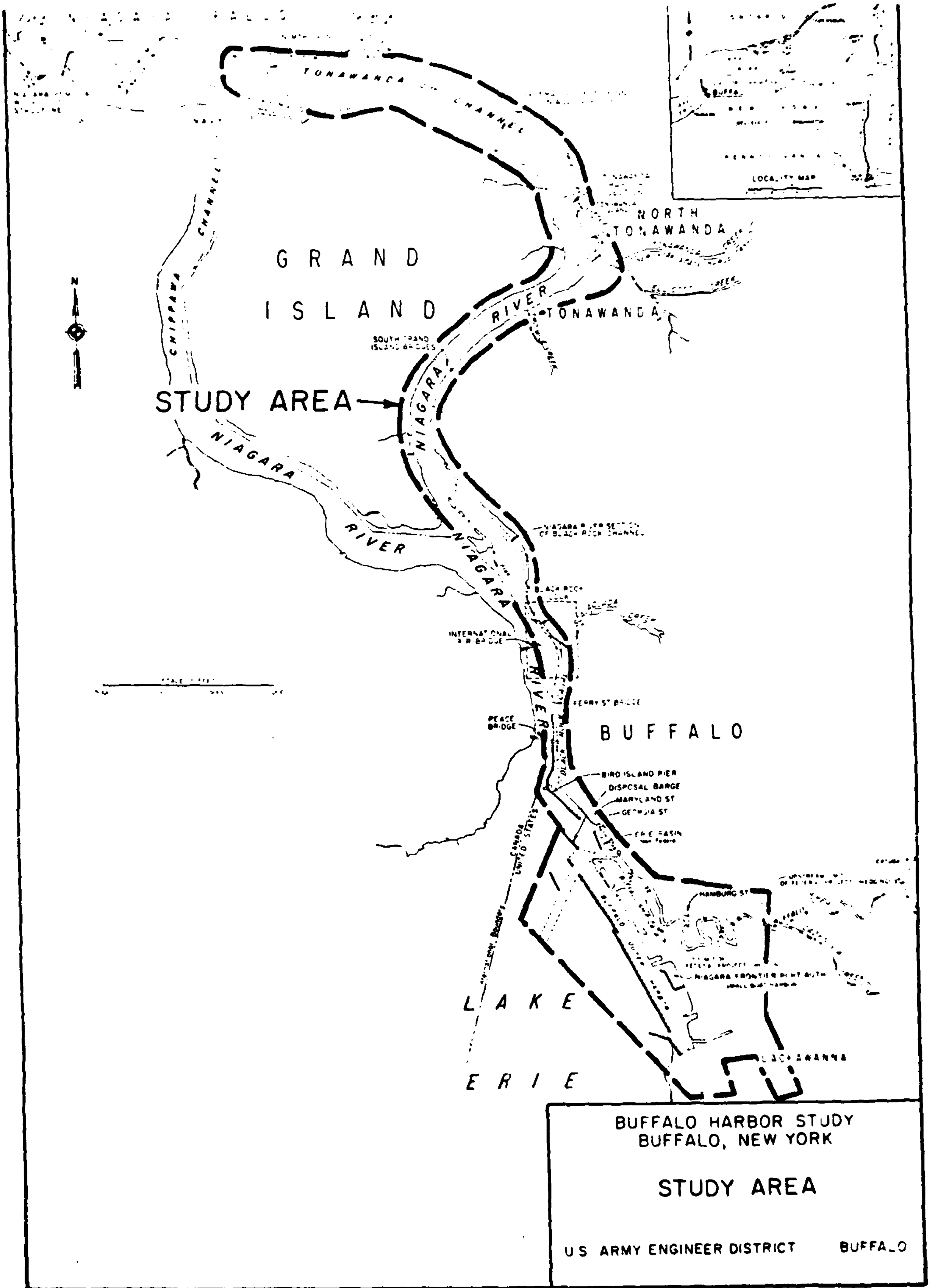
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Alternative III. Implement a one-time cleanup program to rid the harbor of the major structural sources of drift. These sources have been identified in field surveys and consist of dilapidated waterfront structures, loose onshore debris, sunken vessels, and tributary drift.

Alternative IV. Combine Alternatives II and III, for example, implement a one-time cleanup and then have a continuous annual program for the removal of drift as it enters the harbor.

The Drift and Debris Removal Study investigates the feasibility of each of these alternative solutions based on technical, economic, social, and environmental criteria. These solutions will be investigated in sufficient detail so that a determination can be made as to the feasibility of Federal participation in these solutions. This determination will be made and the results of the study published as an appendix to the Buffalo Harbor Preliminary Feasibility Report.

Please feel free to contact Tom Switala or Jim Conley at (716) 876-5454, with any questions you may have regarding the Supplemental Drift and Debris Study or the overall commercial navigation study.



Attachment I

New York State Department of Environmental Conservation
Division of Regulatory Affairs - Region 9
600 Delaware Avenue, Buffalo, NY 14202-1073
(716) 847-4551

Robert F. Flacke
Commissioner

April 6, 1982

Mr. Charles E. Gilbert, Chief
Planning Division
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, NY 14207

Attn. Mr. Thomas Swiatala

Re: Buffalo Harbor Drift and Debris Study

Dear Mr. Gilbert:

In response to your March 3, 1982 letter, please be advised that this Department favors the above-referenced study to determine the advisability of a federal project for the collection, removal, and disposal of drift and its sources in the Port of Buffalo and adjacent waterways.

Alternative IV consisting of a one-time cleanup program to rid the harbor of major sources of drift followed up by a formal annual maintenance program is recommended as the most effective solution to the problem of drift and debris in Buffalo Harbor. However, we are concerned with resuspension/disposal of contaminated bottom sediments excavated incidentally as a result of possible backhoe removal of piling for Alternative III and IV. Please note that per our Solid Waste Unit's review, none of the shorefront structures themselves appear likely to be contaminated with hazardous materials.

Although Alternative II consisting of continuous removal of floating debris during the recreational boating season on a yearly basis is not as thorough a solution as Alternative IV, it would not involve excavating contaminated bottom sediments.

The recommended means of drift disposal is by burning the debris at the Hooker Chemical resource recovery facility in Niagara Falls, New York, and we also favor that approach. The next preferable disposal method would be by incineration in a total mobile combustion unit. The combustion unit would require an Air Resources Permit from this Department. Since available local landfill space is at a premium, the landfill alternative would be the least preferable disposal method from our viewpoint. The Regional Solid Waste Unit should be notified of the haulers involved in transporting the debris and the ultimate disposal site of the debris in order to determine permit requirements (if any).

Thank you for the opportunity to review and comment on this study.

Respectfully,

Steven J. Doleski

Steven J. Doleski
Regional Permit Administrator

JED:jg

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
100 Grange Place
Room 202
Cortland, New York 13045

March 31, 1982

Colonel George P. Johnson
District Engineer, Buffalo District
U. S. Army Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207

Attention: Charles Gilbert, Chief, Planning Division

Dear Colonel Johnson:

This constitutes our Planning Aid Letter on the alternatives for the Buffalo Harbor Drift and Debris Study, submitted in accordance with our February 9, 1982, Scope of Work. This in not to be considered our report under the authority of Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

Drift and debris provide habitat for a variety of fish and wildlife species. Removal of this drift and the cleanup of its sources would cause several adverse impacts to this habitat. The benefits to be accrued by fish and wildlife as a result of these operations would be minimal.

Existing Biological Conditions

The Buffalo River has been beset by pollution problems in the past. However, in recent years, as the water quality of the river has begun to improve, carp (Cyprinus carpio) and white suckers (Catostomus commersoni) have become abundant. Limited numbers of smallmouth bass (Micropterus dolomieui) and brown bullhead (Ictalurus nebulosus) have been found in the river. Benthic invertebrate populations are beginning to recover.

Eastern Lake Erie and the upper Niagara River support an excellent warmwater and coldwater fishery. Among the prominent game species found in the study area are coho salmon (Oncorhynchus kisutch), chinook salmon (Oncorhynchus tshawytscha), rainbow trout (Salmo gairdneri), brown trout (Salmo trutta), lake trout (Salvelinus namaycush), walleye (Stizostedion vitreum), yellow perch (Perca flavescens), rainbow smelt (Osmerus mordax), and muskellunge (Esox masquinongy).

A variety of aquatic vegetation, including water celery, water stargrass, waterweed, and other pondweeds (*Potamogeton* spp.), is present in the study area. These plants provide excellent habitat for a variety of bird species. A man-made area called Times Beach supports populations of ducks, geese, shorebirds, and passerine birds.

The highly developed landscape of the study area limits populations of large mammals. Rodents are the predominant type of mammals found in the study area.

Adverse Impacts of Drift Removal

Floating debris provides habitat for a variety of invertebrates, which in turn provide a food source for many fish species, as well as for some aquatic animals. Loss of this food source would have detrimental effects on the fish populations. Some bird species utilize floating pilings as resting areas and as a perch for spotting fish. Removal of this debris would have minimal adverse impacts on waterfowl and shorebirds.

Adverse Impacts of Debris Cleanup

Old, dilapidated docks and other similar structures provide habitat for many fish species. They provide cover for juveniles and the smaller prey species, while providing foraging areas for larger, predatory species. They are also a major source of shade in this area. These structures provide a place for attachment for a variety of invertebrates, which comprise an important food source for the fish populations of the area. Birds utilize these docks as resting areas, and some species nest upon or under them. Amphibians and reptiles dwell in and around these structures.

Removal of these structures will cause several adverse impacts to the fish and wildlife of the area. Since these structures provide invertebrate habitat, their removal will reduce the food supply for the fish. In addition, substrate could be lost during removal of the pilings, resulting in further loss of invertebrate habitat. The turbidity produced while excavating these structures could adversely impact invertebrates, phytoplankton populations, larval fish, and fish eggs. This turbidity could be particularly harmful if it occurs during the spring spawning season. A related impact is the resuspension of pollutants during removal of pilings and other structures embedded in the sediment.

Shoreline erosion following the removal of structures is another problem. Not only would this cause the loss of terrestrial habitat and valuable shoreline, the resuspension of sediments could cause turbidity and could result in the resuspension of pollutants. Creosote on existing structures could act as a contaminant if allowed back into the water column during the removal of sources of drift.

Should structures be cut into smaller pieces prior to removal, the resulting sawdust could have adverse impacts on the aquatic environment. Layers of floating sawdust could impede light pentration, causing a reduction in phytoplankton and plant growth. Sawdust that is allowed to settle may alter the substrate and reduce the productivity of benthic macroinvertebrates.

Removal of dilapidated structures would also adversely affect fish and wildlife through the loss of shade, cover, nesting, and resting areas. However, the greatest impact on fish and wildlife could come from disposal operations. Landfill disposal will consume several acres of habitat that may be of value to fish and wildlife, depending on the area chosen. Burning of debris could increase air pollution in the area.

Beneficial Impacts of Drift and Debris Removal

There are some potential benefits to fish and wildlife from debris removal. Fish and Wildlife habitat could be improved if areas where structures are removed are allowed to revegetate naturally. Plantings of wildlife food and cover species would also improve the habitat. Some structures to be removed may include rock cribbing. Should this be the case, rocks could be piled in strategic locations, rather than scattered on the bottom. Scattering the rocks could harm the benthic community, while strategically piling them could create additional habitat for fish and invertebrates.

One possibility for disposal that was not discussed in your letter is the creation of artificial reefs. Clean structures could be tied together and anchored in an offshore area, providing excellent fish habitat. The one steel vessel to be removed from the harbor may also have potential as an artificial reef.

Discussion of Alternatives

There are four alternatives included in the drift and debris study. Each of these would include some of the adverse impacts on fish and

wildlife discussed above. The impacts involved with each alternative are discussed below.

Since Alternative I is the no action alternative, no new impacts, either adverse or beneficial, would occur. The only adverse impacts to fish and wildlife occurring under the present emergency drift removal program would be the loss of small quantities of invertebrate habitat and the minor loss of habitat from landfill operations which utilize the debris. These impacts are minimal. There are essentially no beneficial impacts on fish and wildlife with the existing program.

Alternative II, the continuous removal of floating drift, has slightly greater impacts than Alternative I, due to the larger quantities of material being removed, resulting in a greater loss of invertebrate habitat. However, this habitat loss would probably have a negligible effect on the ecological community of the Buffalo Harbor area.

Each of the three alternative disposal methods has a different impact on fish and wildlife resources. Alternative "a", destruction by a total mobile combustion unit, would have virtually no impacts, either adverse or beneficial, other than some air pollution. Alternative "b", re-use through burning to produce energy, would also have virtually no adverse impacts, other than any additional air pollution created by burning the debris. A potential beneficial effect on fish and wildlife would be the reduced energy need. Since this disposal method would provide energy, a certain amount of coal, oil, or wood that would otherwise be used to produce this energy could be saved. The acquisition of each of these three fuels involves the loss of some habitat. These benefits would be minimal, however. Alternative "c", the use of an existing sanitary landfill, would have no beneficial impacts on fish and wildlife resources, and would have the most adverse impacts. The major adverse impact would be the loss of the land used for the landfill. Depending on the type of habitat at the landfill site, this impact could be significant (i.e., several acres of wetland) or insignificant (i.e., an old mine). We would recommend that the Corps use an approved landfill that is not located in or near valuable fish and wildlife habitat.

Alternative III, a one-time cleanup of major sources of drift, has more adverse impacts than the two alternatives presented thus far. All of the adverse impacts discussed earlier would occur under this plan. These include the direct loss of habitat via debris removal and removal

of structures, loss of substrate during structure removal, resuspension of pollutants, turbidity, shoreline erosion, and the effects of sawdust and creosote on aquatic life. The only beneficial impacts associated with the cleanup of drift sources would be any habitat that is created via riprap, plantings, or natural revegetation of these areas. However, the habitat created is probably more than offset by the habitat lost. Since the disposal alternatives are the same as those in Alternative II, the impacts would be the same, only on a larger scale, due to the much larger quantities of material to be disposed of. We also feel the Corps should consider the fourth disposal alternative (artificial reef creation) discussed above. This alternative disposal method would have the most beneficial impacts on fish and wildlife resources.

Since Alternative IV, a one-time cleanup of major drift sources and an annual maintenance program, is essentially a combination of Alternatives II and III, the impacts would be the same as the impacts of these two alternatives combined. Therefore, Alternative IV has the most adverse impacts on fish and wildlife resources of the four alternatives presented.

Ranking of Alternatives

From a fish and wildlife standpoint, Alternative I is the best, since it has the least impacts. However, with proper mitigation measures (discussed below), the Fish and Wildlife Service could support any of the other three alternatives. None of the four alternatives would have severe adverse impacts on the fish and wildlife resources of the Buffalo Harbor Area, provided the material is properly disposed of and no pollutants are resuspended in the water column.

Mitigation Measures

A variety of mitigation measures should be undertaken to limit and compensate for the adverse impacts that this project will have on fish and wildlife resources. Sediments should be analyzed for pollutants before structures are removed to ensure that pollutants will not be resuspended in the water column. Care must also be taken during the removal and disposal of creosoted timbers. All sawdust should be contained and promptly removed. Any removal of structures which will disturb the sediments and increase turbidity should not occur during the fish spawning and nursery season (approximately April 15 through July 15 for those species present in the project area). Unstable shoreline areas should

be riprapped to prevent erosion following removal of structures. Wherever practical, natural or artificial revegetation should be used to restore habitat and prevent erosion. All debris should be recycled when possible, including the creation of artificial reefs from clean timbers and steel vessels. That material which cannot be recycled should be burned for energy or disposed of in an approved landfill.

Abandoned Grain Elevators

There are essentially no adverse impacts on fish and wildlife resources from the removal of grain elevators provided that the material is properly disposed of.

We appreciate the opportunity for input at this stage of the planning process. Please keep us informed of any further developments or decisions regarding this project.

Sincerely yours,

Paul P. Hamilton

Paul P. Hamilton
Field Supervisor

cc:
NYSDEC, Albany, NY
NYSDEC, Buffalo, NY
NYSDEC, Olean, NY
EPA, New York, NY

ES, Cortland, NY:SPatch:PHamilton:pb

NCBOC Re: Buffalo Harbor Drift 30 September 1981

State of New York
Law Department
65 Court Street
Buffalo, NY 14202

Gentlemen:

In February 1965 the Buffalo District completed a report entitled "Review Report on Buffalo Harbor, New York, Black Rock Channel and Tonawanda Harbor, New York, Niagara River, New York, and Tributary Waterways for Collection and Removal of Drift." At that time it was determined that there was no Federal interest in the project and the study was placed in the "deferred" category. In recent years similar studies have been undertaken by the Corps in other parts of the country and have resulted in favorable Corps projects.

Based on these new developments, the Buffalo District has recently obtained approval to reactivate the 1965 drift removal study and include it under the Buffalo Harbor Study authority. The purpose of this study is to determine the advisability of a project for the collection, removal, and disposal of drift in the Port of Buffalo and adjacent areas. It will also determine the feasibility of a one time clean up program to eliminate the sources of drift. The sources of drift under investigation are dilapidated waterfront structures (i.e., old docks, piers, pilings, and abandoned buildings), shorefront dumps, and loose floatable material lying on shore.

To complete this study, I wish to cite those State and local laws and regulations that exist regarding the placement of floatable material in the study area waterways. This would include placement on the bank where it could be washed into the waterway and maintenance, removal and/or rehabilitation of waterfront structures which would prevent dilapidated structures from becoming a source of drift. I, therefore, request that you send me copies of any laws, ordinances, or regulations that the State of New York has dealing with the placement of floatable material on the bank of, or into a waterway and maintenance, removal, and/or rehabilitation of waterfront structures. Negative replies are requested. I would also like copies of any proposed laws, ordinances, or regulations in these areas that are currently being considered by the State.

Sj/2183

NCBOC
State of New York

Thank you for your cooperation in this matter. If you have any questions please contact Mr. H. Frank Parson, Assistant District Counsel, at (716) 876-5454, extension 2183.

Sincerely,

GEORGE P. JOHNSON
Colonel, Corps of Engineers
District Engineer

CF:
NCBOC

Parson
Abretske 30
Hallock CEG
Liddell KM 01
Creeden
Johnson

James D. Griffin
Mayor

Department of Public Works
City of Buffalo, N. Y.

ROOM 502 – CITY HALL – BUFFALO, NEW YORK – 14202 – PHONE 855-5636

Commissioner

John C. Friedline, Jr.
Sr. Deputy Commissioner

August 24, 1982

Colonel Robert R. Hardiman
District Engineer
U. S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Re: Buffalo Harbor Study

Dear Colonel Hardiman:

We have reviewed your July 1982 News Update pertaining to the Buffalo Harbor Study and particularly to the Supplemental Drift and Debris Removal Study.

We wish to encourage you in your study of the debris problem. Also, we would like to request that you consider studying the debris problems in the downstream area of Scajaquada Creek. The area of our concern in the creek is from Delaware Park Lake to the Black Rock Canal.

As you know, the City has almost completed a $7.5 Million project to restore Delaware Park Lake. Although we have effectively eliminated the debris in the lake, we continue to be plagued with debris in the creek, especially in the area behind the Buffalo and Erie County Historical Society Building.

I hope that you will look favorably at our request, and I assure you that we are willing to provide any needed assistance that you may require. If you have any questions or need any additional information, please contact Mr. Joseph Giambra of this department at 855-5613.

Very truly yours,

John C. Loffredo, P.E.
for Commissioner of Public Works

JCL:JNG:imm

cc: Hon. Henry J. Nowak
Hon. James D. Griffin
Hon. William L. Marcy
J. C. Friedline, Jr.

The Council

CITY OF BUFFALO

WILLIAM L. MARCY, JR.
MINORITY LEADER
DELAWARE DISTRICT COUNCILMAN
1413-B CITY HALL
BUFFALO, N. Y. 14202

CHAIRMAN
ECONOMIC DEVELOPMENT COMMITTEE

September 2, 1982

Colonel Robert Hardiman
District Engineer
U. S. Army Corps of Engineers
Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Dear Colonel Hardiman:

I have been informed by the Department of Public Works that the Corps is undertaking a Buffalo Harbor and Supplemental Drift and Debris Removal Study.

I would like to join John Loffredo in encouraging your consideration of the debris problem in the downstream area of the Scajaquada Creek. The problem is excessively visible from the Park and the Expressway and I have had numerous requests to encourage its cleanup.

I would appreciate whatever help you can offer and remain grateful for all of the Corps help with the Delaware Lake Restoration Project.

Sincerely,

Bill Marcy

William L. Marcy, Jr.

WLM:smc
cc: John Loffredo

MED

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